BRYOZOA FROM THE PERMIAN OF WESTERN AUSTRALIA.

PART I. CYCLOSTOMATA AND CRYPTOSTOMATA FROM THE NORTH-WEST BASIN AND KIMBERLEY DISTRICT.

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(Plates iv–v; Fifty-two Text-figures.)

[Read 30th August, 1944.]

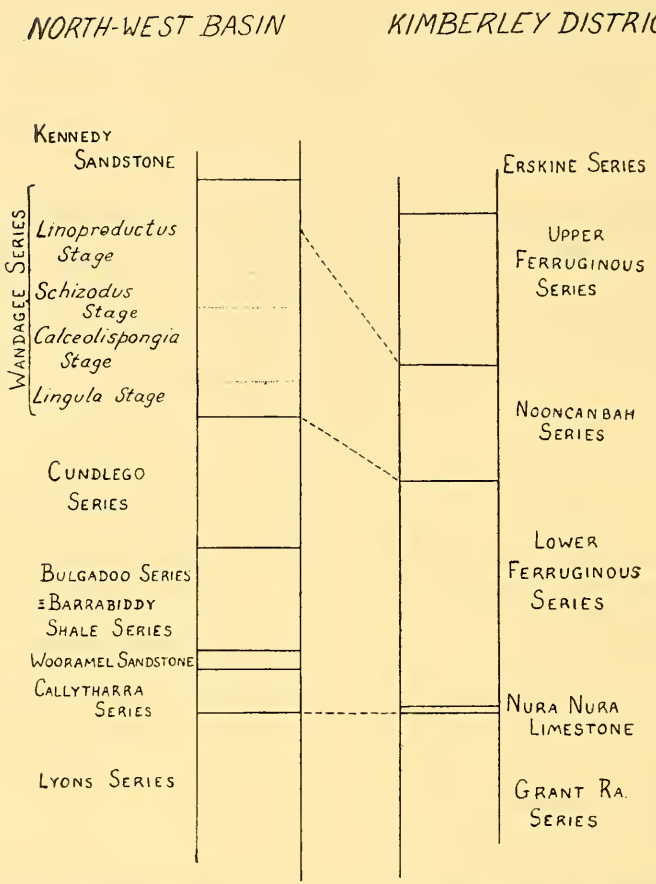
Introduction.

The marine Permian strata of Western Australia contain an abundant and varied bryozoan fauna, of which only a small part has so far been described. In this paper six species whose descriptions were originally published by R. W. Bretnall in 1926 (as *Coscinium* (?) *australe* Bretnall, *Sulcoretepora* (?) *meridianus* Etheridge, *Rhombopora multigranulata* Bretnall, *R. mammillata* Bretnall, *Streblotrypa marmionensis* Etheridge, and *S. etheridgei* Bretnall) are revised from a study of the type material, a number of new species belonging to the genera *Fistulipora*, *Hexagonella*, *Fenestrellina*, *Minilya*, *Penniretepora*, *Septopora*, *Synocladia*, *Rhombocladia*, and one new genus, *Strebloclad ia*, are described and figured, and record is made of the occurrence in Western Australia of species of *Goniocladia*, *Fenestrellina*, and *Protoretepora*. A small collection of specimens recorded previously (Raggatt, 1936, 128) from the Callytharra as species which were originally described from the Upper Pennsylvanian Graham Formation of Texas are amongst those described in this paper.

The collections on which this work has been based comprise specimens from the Barrabiddy shales, and the Cundlego, Wandagee, and Nooncanbah Series from the University of Western Australia Collection, and specimens from the Australian Museum Collection (from the Wandagee and Nooncanbah Series) and the Commonwealth Palaeontological Collection (from the Callytharra Series). My thanks are due to Dr. C. Teichert, of the University of Western Australia, to Mr. Fletcher, of the Australian Museum, and to the Commonwealth Palaeontologist, Miss Crespin, for lending me these specimens and for the information they have so willingly given me about them, and to Dr. Ida Brown for the help she has given me during the preparation of this paper. The photographs were taken by Mr. H. G. Gooch.

The fauna contained in the collections available is extremely varied, and although species belonging to some of the most important genera are described in this paper, other genera of equal importance are not touched upon—for example, no Batostomellidae are described here, although Stenoporids form one of the most abundant groups in the fauna, and *Batostomella* and closely allied genera are also common and represented by a large number of species. No general discussion of the age of the fauna is, therefore, attempted here.

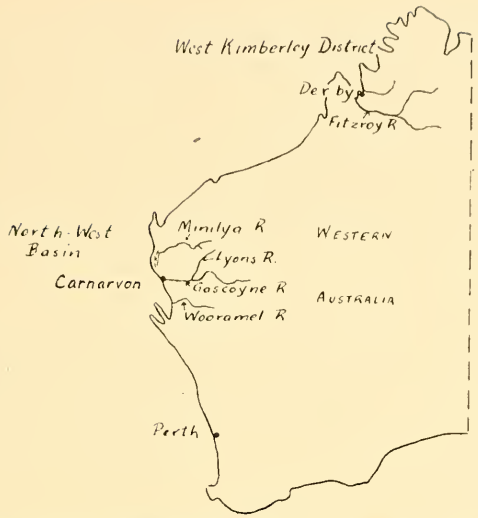
Fistulipora, although it is one of the most abundant and characteristic forms in the fauna, has not hitherto been recorded from these beds, apart from the records as *Dybowskiella*, made by Chapman (in Raggatt, 1936, 128)—quoted by Raggatt and Fletcher (1937, 171)—and by Teichert (1940, 383, 406). It is represented by a large number of species—massive, fine and coarse ramose, and incrusting forms—of which only the massive species from the Wandagee and Nooncanbah Series are described in this paper. It was expected that an examination of this group of massive species, which is abundantly represented in the Permian of Timor, would reveal some species identical with the Timor forms, to which some of the Western Australian species show a general



Text-fig. A.—Generalized sections of the Upper Palaeozoic succession in the North-West Basin and the Kimberley district of Western Australia; the base of the Callytharra Series and of the Nura Nura Limestone is approximately the horizon of the Sakmarian-Artinskian boundary; the succession shown for the North-West Basin is that found in the Minilya River district. (Taken mainly from Teichert, 1941, 390.) Scale of the order of 2,000 feet : 1 inch.

external resemblance. Examination of the internal structure of the massive Western Australian species has, however, shown that there is no massive species so far known which could be at all closely compared with any species from Timor, although the general aspect of the species is similar, and they clearly represent a similar stage in the development of the genus. The related form *Hexagonella* is one of the most abundant genera in this bryozoan fauna. The species here described are, with the exception of *Hexagonella australe* (Bretnall), all from the Wandagee or Nooncanbah Series. The three previously described species of this genus, from the Salt Ra. of India and the Permian of Timor, are all species with comparatively narrow, ribbon-like branches, and this group of species is represented in the Callytharra by a number of species, of which *Hexagonella australe* is one. Species of *Hexagonella* with broad, frond-like zoaria are less common in the Callytharra than the ribbon-like species, but in the higher beds of the Wandagee and Nooncanbah Series, frond-like species quite distinct from any previously described forms are so far the only ones known to occur. So far no species of *Fistulipora* or of *Hexagonella* has been found common to the Wandagee and the Nooncanbah.

"*Sulcoretepora*" *meridianus* (Etheridge) differs from *Sulcoretepora*, which it closely resembles externally, in its internal structure, which is not closely comparable with that of any genus so far described. *Goniocladia timorensis* Bassler, which is here recorded from the Nooncanbah Series, was originally described from the Basleo Beds of Timor.



Text-fig. B.—Sketch map of Western Australia, to show the districts from which the specimens described in this paper were collected.

The species of *Fenestrellina* and *Minilya* here recorded and described are specimens which were previously recorded from the Callytharra by Chapman (in Raggatt, 1936, 128) as *Fenestella pectinis* Moore and *Fenestella spinulifera* Moore; these two species were originally described from the Wayland Shale of the Graham Formation (Pennsylvanian) of North-Central Texas. These identifications are not confirmed here; one of the specimens recorded as *Fenestella pectinis* is here identified as *Fenestrellina horologia* (Bretnall), of which *F. parviuscula* Bassler, described from the Bitaoeni and Basleo Beds of Timor, and since recorded from the Permian of Vancouver Island, is a synonym; *F. horologia* occurs also in the Wandagee and Nooncanbah Series, in the Permian of the Northern Territory, and in the Dilly Stage in Queensland; and three of the specimens recorded as *Fenestella spinulifera* are identified as *Fenestrellina affluensa* (Bretnall); the remaining specimens are referred to new species of *Fenestrellina* and *Minilya*. Chapman (in Raggatt, 1936, 128) also recorded *Pinnatopora trilineata* var. *texana* Moore, described from the Wayland Shale of Texas, from the Callytharra; this species from the Callytharra is here described as *Penniretepora triporosa*, n. sp., and although it and *P. fossata*, n. sp., show a strong general resemblance to species described from the Wayland Shale, no species identical with any North American form has so far been found. The species of *Septopora* and *Synocladia* described here could not be confused with any previously described species, but are typical members of these genera, both of which are widespread in late Palaeozoic deposits in other parts of the world.

Rhabdomeson shanse Reed, from the Anthracolithic of Burma, is here considered a synonym of *R. mammillata* (Bretnall), from the Nooncanbah Series, and *R. bispinosa*, n. sp., from the Callytharra, is a form very similar to *R. consimile* Bassler, from the Basleo and Amarassi Beds of Timor. It is also considered probable that specimens described from the Bitaoeni and Basleo Beds of Timor as *Streblotrypa germana* Bassler should be referred to *S. marmionensis* Etheridge, which is a very common and widespread form in Western Australia. The occurrence in Western Australia of two very rare genera, *Rhombocladia*, of which, although it is known to occur in North America, Italy and Russia, only two species have so far been described, and *Strebloclad*ia, n. gen., to which *Septopora* ? *elliptica* Warthin from the Pennsylvanian of Oklahoma is also referred, is interesting in emphasizing the wide and representative variety of bryozoan genera present in the Western Australian Permian, and their presence also emphasizes the fact that, although no species have so far been found common to these two widely separated deposits, there is a strong similarity in the general type of bryozoan fauna between the Callytharra and the Graham Formation of Texas and rocks of equivalent

age in Oklahoma, probably due to deposition in a similar type of facies and at a not very widely differing age. The Western Australian fauna on the whole, as can be seen from the species described in this paper, shows a much closer general similarity to the faunas of Timor and of the Salt Ra. than to the Permian faunas of Eastern Australia, where the range of genera present is much more restricted—Fenestrellinidae and Batostomellidae, with a few Rhabdomesontidae and Acanthocladiidae, are the only families so far known to occur, although abundant faunas with a wide variety of species are developed—but a few species are common to Eastern and Western Australia, as for example *Protoretepora ampla* (Lonsdale), which occurs in New South Wales in the Muree Stage of the Upper Marine Series, and is recorded in this paper from the Nooncanbah Series.

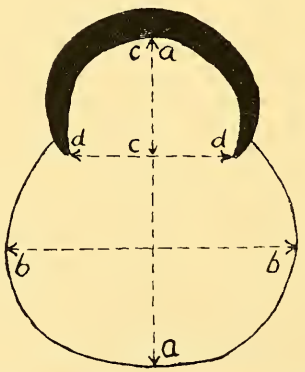
The holotypes of three of the species revised here, "*Sulcoretepora*" *meridianus* (Etheridge), *Rhombopora multigranulata* Bretnall, and *Rhabdomeson mammillata* (Bretnall), form part of a collection of specimens numbered 10930, Western Australian Geological Survey Collection. Bretnall gave the locality of these specimens as Gascoyne River district, but they are identical in matrix, in the preservation of the fossils, and in the fauna present, to other specimens used by Bretnall in the course of his work and now in the Australian Museum Collection, whose locality is catalogued as Mt. Marmion; comparison of these with many specimens from this locality in the University of Western Australia Collection leaves little doubt that all of these specimens are from the same locality, and that the type locality of these species should be corrected to Mt. Marmion. Other specimens whose locality was given by Bretnall as Gascoyne River district, e.g., 2/2405, W. Aust. G.S. Colln., on which are the holotypes of *Fenestrellina horologia*, *F. affluensa*, and *Ramipora ambrosoides*, are quite distinct from those labelled 10930, being shaly limestones, probably from the Callytharra Series in the Gascoyne River district.

Description of Species.

Order Cyclostomata Busk.

Family Fistuliporidae Ulrich.

In measurements of specimens of Fistuliporoids, the spacing of the zooecia is here given, in species with irregular arrangement of the apertures, as the number of zooecia in a field of 7 sq. mm., the measurements always being made exclusive of maculae, as when the apertures are not regularly arranged this gives a clearer idea of their spacing than do the customary linear measurements of distance between the apertures. In measuring the size of the zooecial tubes, the longer and shorter diameters of the tubes were measured where the tubes are not deeply indented by the lunaria, otherwise the measurements are given (see Text-figure C) as suggested by Nikiforova (1933, Text-fig. 3).



Text-fig. C.—Diagrammatic transverse section through a zooecium of *Fistulipora*, marked to show the method used in this paper for measuring the zooecia.

Genus Fistulipora McCoy, 1850.

Fistulipora McCoy, 1850, 131; *Fistulipora* McCoy, Ulrich, 1890, 382, 474; Bassler, 1929, 41.

Genotype: *Fistulipora minor* McCoy, 1850.

Range: Ordovician to Permian.

Zoarium incrusting to massive or ramose, surface with monticules or maculae composed of aggregations of vesicles or of enlarged zooecia; zooecial tubes with faint to strongly developed lunaria, and usually with diaphragms; interzooecial spaces occupied by vesicular tissue, sometimes replaced by dense tissue near the surface.

The massive species, only, of *Fistulipora* from the Wandagee and Nooncanbah Series, are described in this paper.

Fistulipora vacuolata, n. sp. Text-figs. 1, 2.

Horizon and locality: Limestone horizon, highest fossil horizon of Nooncanbah Series, on east side of Mt. Marmion, near gully from saddle. Coll. Caltex.

Holotype: Specimen 22126, Univ. W. Aust. Colln.

Massive Fistulipora, *maculae small; zooecia large, not indented by the thick lunaria, diaphragms numerous; vesicular tissue very coarse.*

The zoarium is massive and fairly large, the largest specimen, which is incomplete, being about 7 cm. long and up to 4 cm. in height. Generally the zooecial tubes are continuous throughout the height of the colony, but some discontinuous layers are developed. The surface is not well enough preserved to show the maculae; these maculae are shown in transverse sections, and are composed of aggregations of vesicles about 1 mm. in diameter.

The zooecia are tubular, rather thick walled, rounded in cross-section, and not usually indented by the lunarium. This lunarium occupies one-third to one-half of the circumference of the tube, and may be very strongly thickened, though this is not always the case; in spite of its frequently great thickness, it is often not conspicuous in sections of these specimens, since the tubes are not indented, and the specimens from this locality are often very iron-stained, so that details of their structure are not always clearly shown. The zooecia usually measure: a, 0·38–0·55 mm.; b, 0·36–0·57 mm.; c, 0·06–0·16 mm.; d, 0·28–0·48 mm.; but both larger and smaller zooecia sometimes occur. The number of zooecia in 7 sq. mm. is 15 to 22. The diaphragms are rather thick; their spacing is very variable, but usually they are between 0·4 and 1·25 mm. apart; from 4 to 7 diaphragms occur in 3 mm. The vesicles are angular and very coarse, particularly in longitudinal section; they occur usually in one or two rows between adjacent zooecia, but they do not always completely separate the zooecia; at irregular intervals throughout the zoarium zones are developed in which the vesicles are rather flattened for a short distance—about 1 mm.; they are not replaced by dense tissue near the surface.

Fistulipora crescens, n. sp. Pl. iv, Fig. 1; Text-figs. 7, 8.

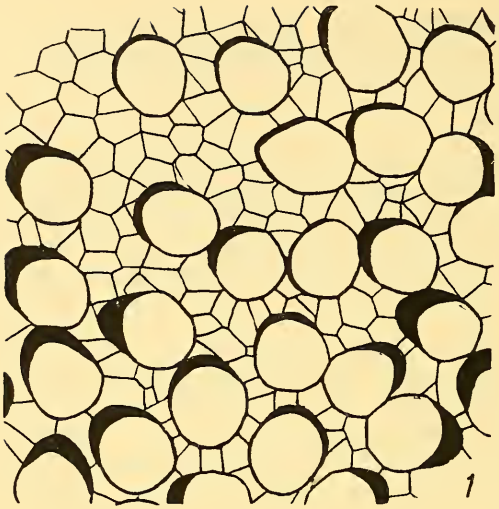
Horizon and locality: Highest fossil horizon of Nooncanbah Series, south-east side of Mt. Marmion, near foot of slope. Coll. C. Teichert.

Holotype: 22123*a*, Univ. W. Aust. Colln.

Massive Fistulipora; *zooecia small, strongly indented by thick lunaria; diaphragms thick, irregularly spaced; vesicular tissue simulating mesopores in vertical section.*

The zoarium is massive in appearance, being built up of a number of discontinuous lamellae of variable width, some lamellae being very narrow, while in other parts of the same colony individual zooecial tubes may extend throughout the zoarium. The colonies are irregular in shape, reach 5 cm. in length and are up to 2·5 cm. in height. The sides of the colony may be infolded near the base, which is covered by a thin, concentrically wrinkled theca. Occasional small maculae, composed of aggregations of vesicles and appearing solid at the surface, occur on the surface of the colony, but they are not regularly arranged.

The zooecia are erect, and are strongly indented by the ends of the lunaria; the size of the tubes in cross-section is: a, 0·32–0·41 mm.; b, 0·29–0·43 mm.; c, 0·08–0·14 mm.; d, 0·19–0·25 mm.; they are closely spaced, 18 to 29 in 7 sq. mm. Lunaria are well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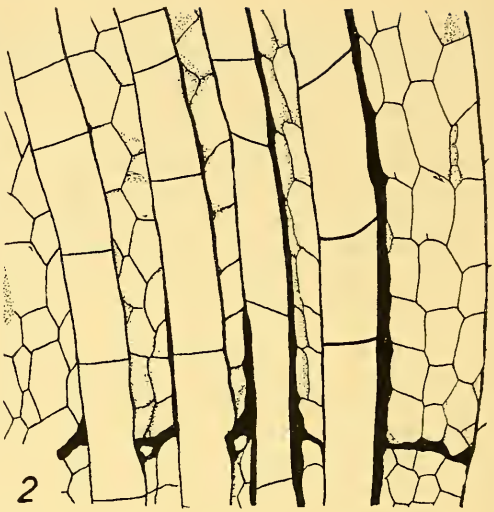
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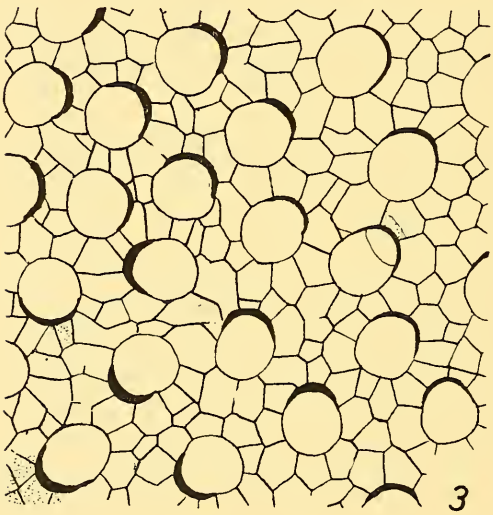
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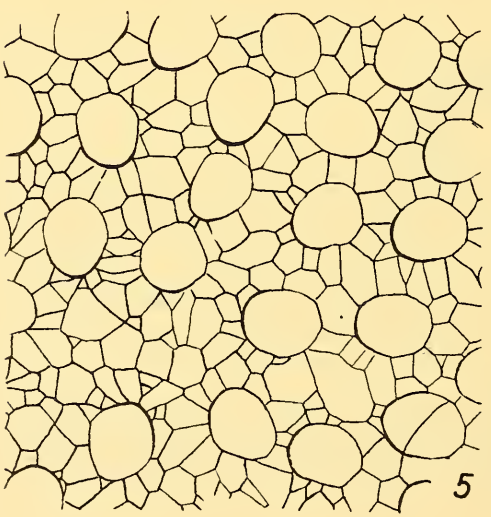
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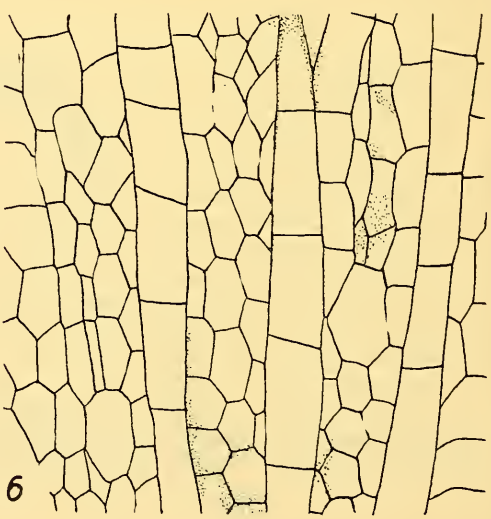
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developed and fairly strongly thickened; they occupy about one-quarter to one-third of the circumference of each tube; at the surface they project as hoods over the apertures. The rather thick diaphragms are irregularly spaced, but are most often between 0·45 and 0·75 mm. apart, 4 to 7 occurring in 3 mm. The zooecial tubes are separated from one another by flattened vesicles, simulating closely tabulated mesopores in vertical section; these vesicles are angular in cross-section, and occur in one or two, less often more, rows between adjacent zooecia; they are not infilled by dense tissue as they approach the surface, though there is a tendency for them to become thicker walled and less angular.

FISTULIPORA WADEI, n. sp. Text-figs. 5, 6.

Horizon and locality: Highest fossil horizon of Nooncanbah Series, south-east side of Mt. Marmion, near foot of slope. Coll. C. Teichert.

Holotype: 22124, Univ. W. Aust. Colln.

Massive Fistulipora; *zooecia large, with thin lunaria, which do not indent the tubes; diaphragms numerous; vesicular tissue coarse.*

The zoarium is massive, hemispherical in shape; it is comparatively small, about 3·25 cm. long and 2·5 cm. high; one weathered surface gives an oblique section through the zoarium, and is marked by ridges representing pauses in growth, which can be traced in sections as a line of flat-topped vesicles, but the zooecia are continuous throughout the colony. The surface is rather weathered, and maculae are not well shown on it, though they appear in sections as aggregations of vesicles about 1 mm. in diameter, irregularly arranged, but of fairly frequent occurrence.

The zooecia are oval in cross-section; they are not usually indented by the lunaria, which are only slightly thickened but extend around one-third to one-half of the circumference of each tube. Measurements of the zooecia are: a, 0·41–0·49 mm.; b, 0·36–0·44 mm.; c, 0·01–0·16 mm.; d, 0·3–0·36 mm. There are rather constantly 17 to 18 zooecia in 7 sq. mm. The diaphragms are very thin and irregularly spaced, being usually between 0·3 and 1·25 mm. apart, with from 4 to 6 in 3 mm. The vesicles are very coarse, angular, and thin walled, and are not infilled by dense tissue near the surface; usually there are one or two rows of vesicles between the zooecia, but rarely adjacent zooecia are in contact.

FISTULIPORA COMPACTA, n. sp. Text-figs. 3, 4.

Horizon and locality: Unknown horizon of Calceolispongia Stage of the Wandagee Series, Syncline west of Coolkilya Pool, Minilya R.

Holotype: 22129, Univ. W. Aust. Colln.

Massive Fistulipora; *zooecia large, usually little indented by slightly thickened lunaria; diaphragms numerous; vesicular tissue coarse.*

The zoarium is small and massive, reaching a maximum height of 2·3 cm. and width of 2·1 cm. The base of the colony is sub-circular, concave, and covered by a thin theca. The large zooecial apertures are protected by slightly raised lunaria; the vesicles are closed at the surface. Small maculae composed of aggregations of vesicles occur irregularly.

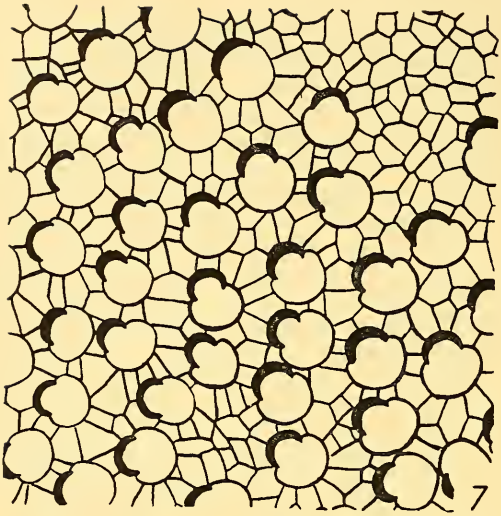
The zooecia are tubular, sub-circular in transverse section, and very slightly indented by the lunaria. The lunaria are not greatly thickened; they extend around one-third to nearly one-half of the circumference of each tube. Measurements of the size of average zooecia are: a, 0·39–0·44 mm.; b, 0·36–0·44 mm.; c, 0·1–0·22 mm.; d, 0·26–0·4 mm.; but both larger and smaller zooecia rarely occur. There are 17 to 19 zooecia in 7 sq. mm.

Text-figs. 1-2.—*Fistulipora vacuolata*, n. sp. Thin sections of the holotype, × 20. 1. Tangential section, with part of a macula shown in the upper left hand corner. 2. Vertical section. (Slides 41184, 41185, Univ. W. Aust. Colln.)

Text-figs. 3-4.—*Fistulipora compacta*, n. sp. Thin sections of the holotype, × 20. 3. Tangential section. 4. Vertical section. (Slides 41190, 41191, Univ. W. Aust. Colln.)

Text-figs. 5-6.—*Fistulipora wadei*, n. sp. Thin sections of the holotype, × 20. 5. Tangential section; part of a macula is shown in the lower right hand corner. 6. Vertical section. (Slides 41179, 41180, Univ. W. Aust. Colln.)

All the text-figures were drawn with the aid of a *camera lucida*.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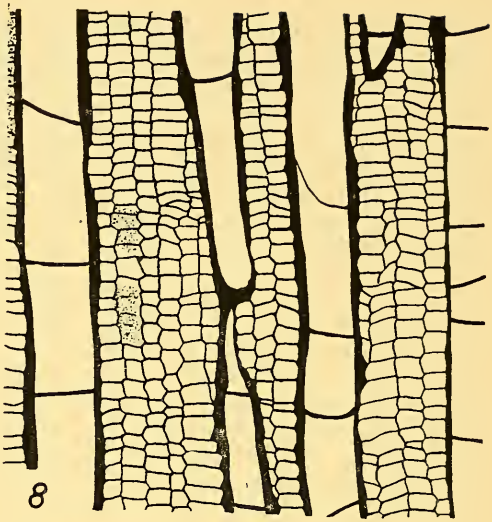
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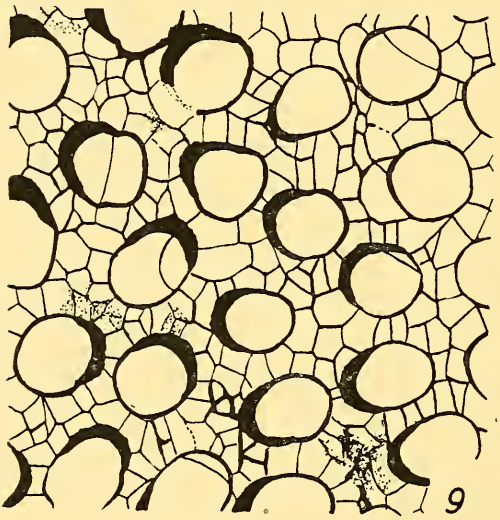
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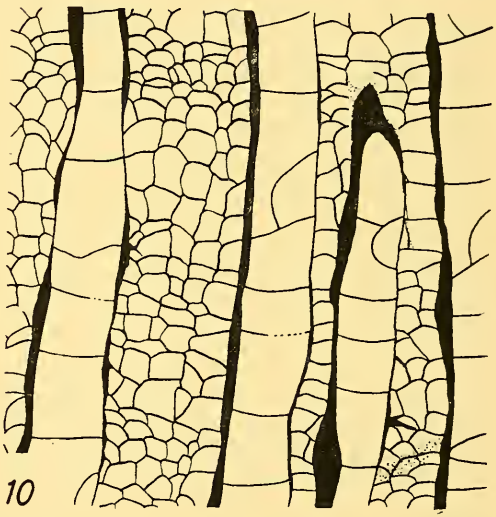
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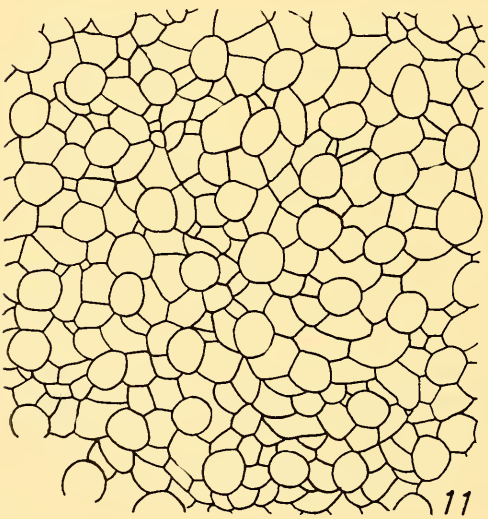
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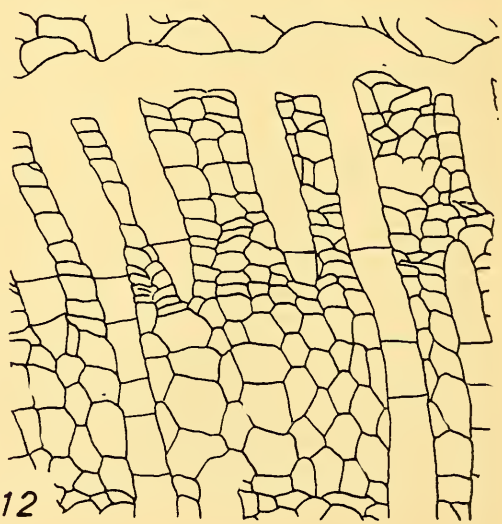
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Thin, complete, straight or oblique diaphragms are abundant in the zooecial tubes; they are most usually spaced between 0·25 and 0·8 mm. apart, with from 6 to 9, and usually 7, in 3 mm. The zooecia are usually completely separated by thin walled vesicles, which are angular and very coarse; they occur most frequently in one, but may be in two or more, rows between adjacent zooecia, and are not modified in any way as the surface is approached.

FISTULIPORA CONICA, n. sp. Text-figs. 9, 10.

Horizon and locality: From strata in the lower 150′ of Calceolispongia Stage of Wandagee Series, east limb of Syncline west of Coolkilya Pool, Minilya R. (holotype). Coll. H. Coley; and west limb of this syncline, ¼ mile west of shale outcrop on north bank of Minilya R. (F 37592, Aust. Mus. Colln.). Coll. H. Coley.

Holotype: 22130, Univ. W. Aust. Colln.

Massive Fistulipora; *zooecia large, with strongly thickened lunaria, which slightly indent the tubes; diaphragms numerous; vesicular tissue coarse.*

The zoarium is massive and fairly large, the holotype being about 3·5 cm. high and about 5 cm. wide. The zooecial apertures are large and are prominent on the surface; where the surface is not weathered the lunaria form hood-like projections above the apertures and the surface between the apertures is smooth and solid, but slight weathering removes the lunaria and exposes the coarse vesicles which separate the zooecial tubes. Small maculae composed of aggregations of vesicles occur at distant and irregular intervals.

The zooecia are tubular, with rather thick walls, and they are only slightly indented by the lunaria; the lunaria vary in development in different parts of the one section; typically the lunarium extends around one-third to one-half of the circumference of the tube, and is strongly thickened, with the outer margin rather frilled, but in parts of the sections, as in the upper right hand corner of Text-figure 9, the lunaria are only very slightly thickened; the size of the tubes is also variable: a, 0·38–0·56 mm.; b, 0·32–0·57 mm.; c, 0·01–0·19 mm.; d, 0·27–0·43 mm.; large zooecia are more common than the smaller ones. In 7 sq. mm. there are from 12 to 16 zooecia. Diaphragms are numerous, usually they are placed between 0·25 and 0·95 mm. apart, with from 5 to 8 in 3 mm.; generally they are straight or only slightly concave, but very strongly curved diaphragms like large cystiphragms in appearance occur occasionally in many of the tubes. The zooecial tubes are separated by coarse vesicular tissue, there being usually one or two, rarely three, rows of vesicles between adjacent tubes.

FISTULIPORA GIGANTEA, n. sp. Text-figs. 11, 12.

Horizon and locality: Highest horizon with *Pseudogastrioceras goochi* Teichert, 1942 (223), Linoproductus Stage of the Wandagee Series, about 8 chs. east of foot of Wandagee Hill, north-east of South-Western Gully. Coll. C. Teichert.

Holotype: 22127, Univ. W. Aust. Colln.

Very large, massive Fistulipora; *zooecia small, lunaria very weakly developed and not thickened; diaphragms numerous; vesicular tissue very coarse.*

Zoarium massive and very large, the largest specimen being 14 × 9·5 cm., and about 7 cm. high at the highest point; the colony is built up of a number of discontinuous layers of varying thickness, often distinct on weathered surfaces; the base is incrusting, and the upper surface is extremely irregular and is thrown up into a number of lobes; small, sometimes slightly raised maculae, about 2 mm. in diameter, and composed of aggregations of vesicles, occur on the surface, spaced about 5 to 8 mm. apart.

The zooecia are tubular, and are rounded to slightly oval in cross-section; lunaria are very poorly developed, occasionally the zooecial wall is curved to a slightly shorter

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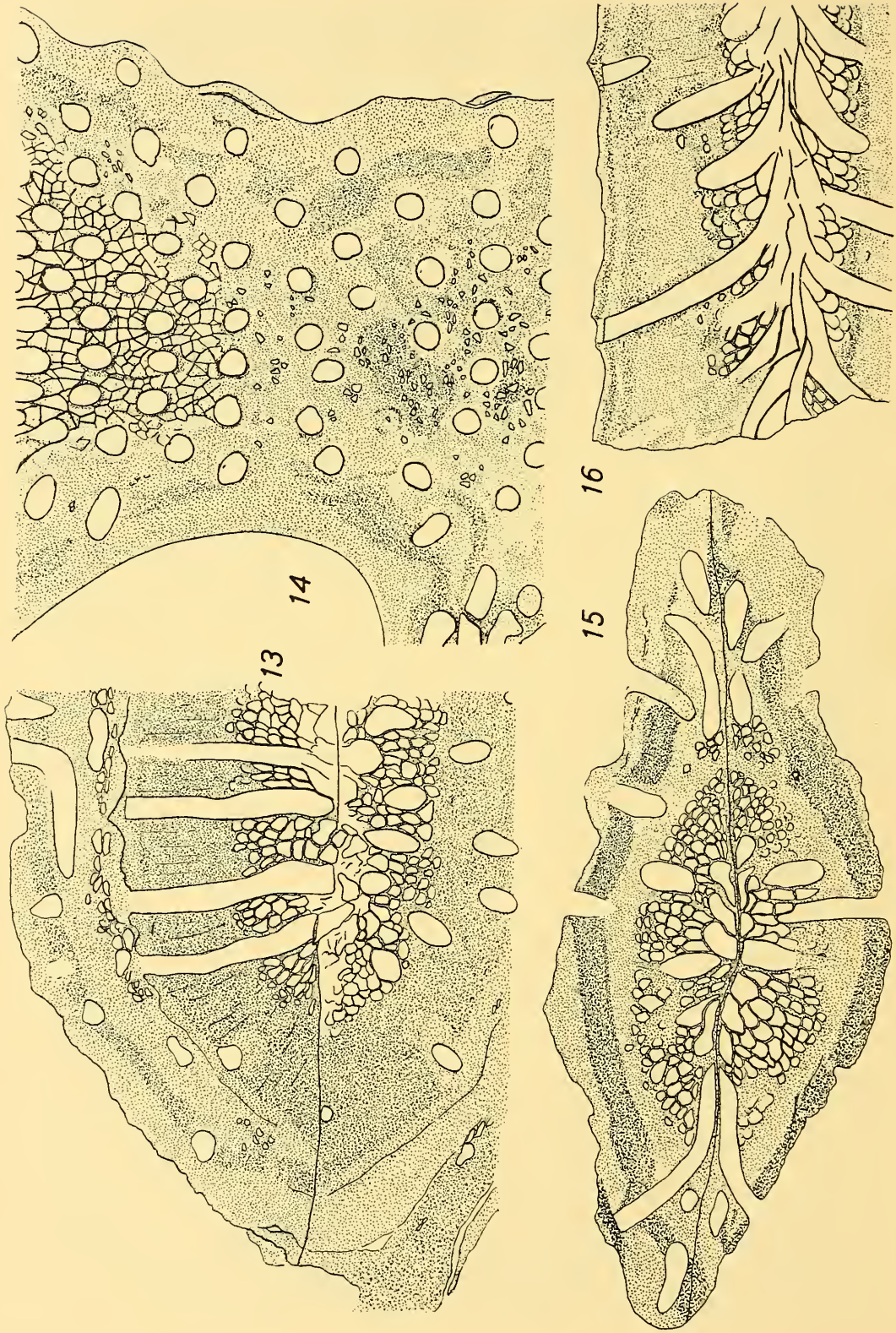
Text-figs. 7-8.—*Fistulipora crescens*, n. sp. Thin sections of the holotype, × 20. 7. Tangential section; part of a macula is shown in the top right hand corner. 8. Vertical section. (Slides 41177, 41178, Univ. W. Aust. Colln.)

Text-figs. 9-10.—*Fistulipora conica*, n. sp. Thin sections of the holotype, × 20. 9. Tangential section. 10. Vertical section. (Slides 41192, 41193, Univ. W. Aust. Colln.)

Text-figs. 11-12.—*Fistulipora gigantea*, n. sp. Thin sections of the holotype, × 20. 11. Tangential section. 12. Vertical section. (Slides 41186, 41187, Univ. W. Aust. Colln.)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radius around one-quarter to one-third of the circumference, but there is no thickening, and the great majority of the tubes appear to be completely devoid of lunaria. The measurements of the zooecia are: a, 0·22–0·32 mm.; b, 0·22–0·33 mm.; c, 0·06–0·08 mm.; d, 0·14–0·17 mm.; about 29 to 33 zooecia occur in 7 sq. mm. The diaphragms are thin, placed 0·15 to 1·0 mm. apart, with 6 to 8 in 3 mm. The zooecia are completely separated by vesicular tissue; this is usually very coarse with angular vesicles often as large in cross-section as the zooecial tubes, but at irregular intervals, and particularly in the upper 1·5 to 2·0 mm. of a layer, the vesicles become much flatter and smaller in cross-section, giving quite a different appearance to both vertical and transverse sections.

Genus Hexagonella Waagen and Wentzel, 1886.

Hexagonella Waagen and Wentzel, 1886, 909, 911; *Hexagonella* Waagen and Wentzel, Bassler, 1929, 50.

Genotype: *Hexagonella ramosa* Waagen and Wentzel, 1886.

Range: Permian.

Zoarium bifoliate, internal structure Fistuliporoid, with lunaria usually absent, sometimes present; interzooecial spaces and maculae occupied by vesicular tissue, often replaced by dense tissue as the surface is approached; surface in some species divided by fine ridges into polygonal areas.

Bifoliate Fistuliporoids, including species with broad frond-like zoaria, as well as species with narrow ribbon-like zoaria more like the genotype in external appearance, form an abundant and varied group in this fauna. Bassler (1929, 50) has suggested that the generic name *Hexagonella* should be retained for "bifoliate species with fistuliporoid internal structure save that lunaria are absent"; *Hexagonella turgida* Bassler from the Timor Permian shows slight lunaria at the surface, but there is no trace of lunaria in sections of this species or of the Indian species described by Waagen and Wentzel. In the majority of the Western Australian species lunaria are either absent or only poorly developed in sections, though they are in some of these forms distinct at the surface, but in some species, as in *H. undulata*, n. sp., they are more strongly developed and the zooecial tubes are bipetaloid in section. These bifoliate Fistuliporoids form such a distinct and compact group in this fauna, and there is such a gradual variation in the development of the lunarium in the different species, that it is here considered that the definition of *Hexagonella* should be extended to include species in which lunaria are developed.

In comparing sections cut parallel to the surface in these species, it is essential to deal with sections cut at about the same level in the zoarium, as there is a great deal of variation in structure from the centre to the surface; near the centre of the zoarium such sections pass through the mesial lamina and the recumbent part of the zooecial tubes adjoining it; above this, there is usually a zone in which the tubes are separated by vesicular tissue which is much coarser than that nearer the surface, and as the surface is approached, sections vary in appearance as the layers of dense and vesicular tissue are intersected; the development of the type of structure characteristic of a species is best studied, in tangential sections, in sections cut fairly close to the surface.

Hexagonella australe (Bretnall) is the only Callytharra species dealt with in this paper. The other species described are from the Barrabiddy shales, and the Wandagee and Nooncanbah Series.

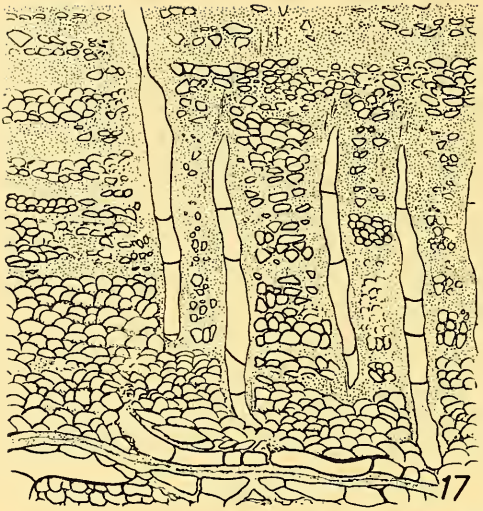
Hexagonella australe (Bretnall), 1926. Pl. iv, fig. 3; Text-figs. 13–16.

Coscinium (?) *australe* Bretnall, 1926, 25, Pl. i, fig. 5, Pl. ii, fig. 2.

Horizon and locality: Callytharra Stage, Fossil Hill, Wyndham R.

Holotype: 2/2405 G, W. Aust. Geol. Surv. Colln., figured by Bretnall, 1926, Pl. ii, fig. 2 (the magnification of this figure is × 1⅓ approx. and not × 4, as stated by Bretnall).

Text-figs. 13-16.—*Hexagonella australe* (Bretnall). Thin sections of the holotype, × 20. 13, 15. Transverse sections, 13 cut closer to the base of the zoarium, and showing the branches thickened by rejuvenation: the original branch at this level was also thicker in proportion to its width than at the level cut in 15. 14. Tangential section, passing obliquely from near the surface, where the zooecia are separated by dense tissue, to near the centre, where they are separated by vesicles. 16. Vertical section; the zoarium has been slightly shattered along the line of the mesial lamina.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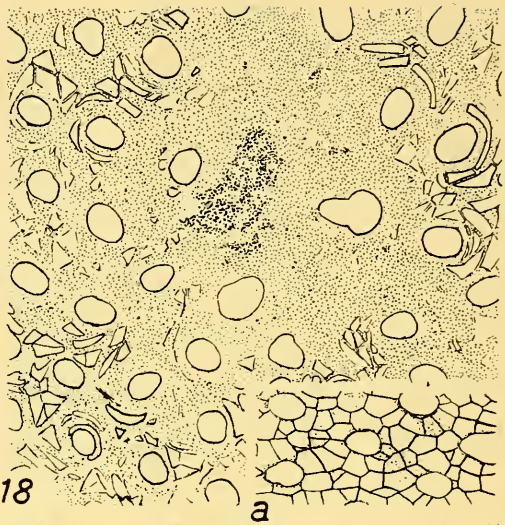
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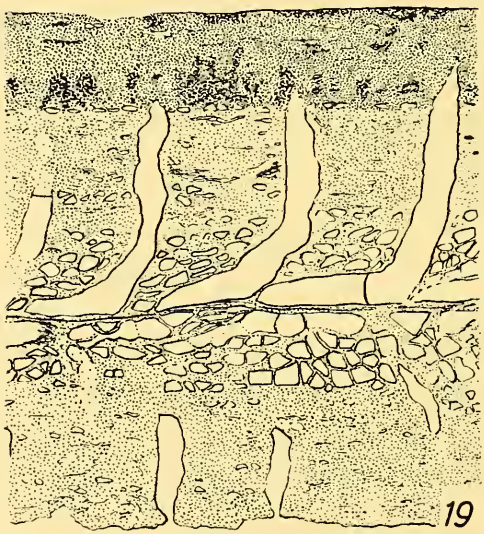
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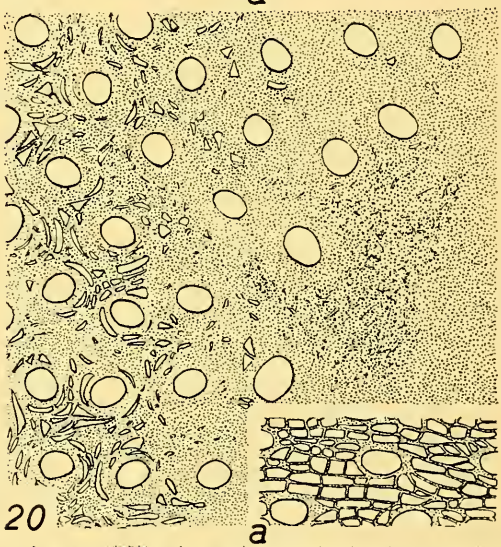
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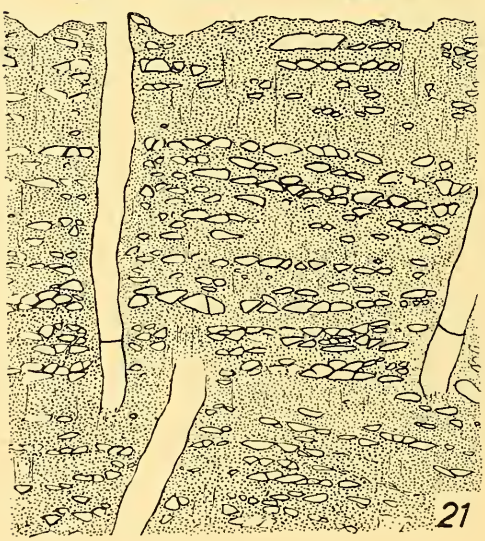
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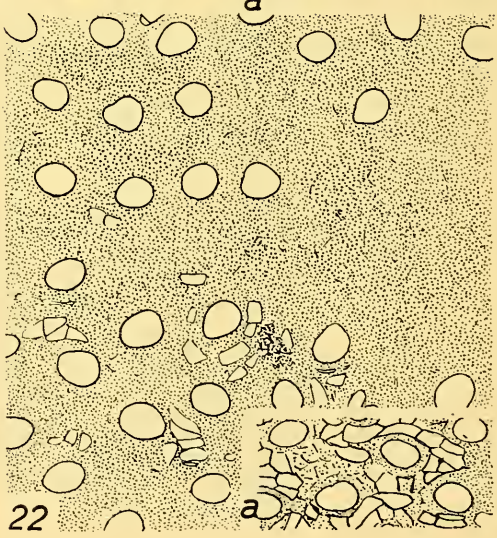

22 a

Narrow, ribbon-like Hexagonella, *zoarium with lobate margins; zooecia small, sometimes with faint lunaria, without diaphragms; vesicular tissue fairly fine, replaced by dense tissue as the surface is approached.*

The zoarium is bifoliate, and consists of rather flattened branches, typically about 5 to 7 mm. in diameter, with lobate margins, and which branch in the same plane, and usually into three, at irregular intervals. There is no sign of any reticulation of the branches, and the "fenestrules" described by Bretnall apparently refer to the irregular spaces partly enclosed by the branches and their lobate margins. The lobes are opposite, and are placed about 6 mm. apart; they may develop into lateral branches. The zooecial apertures are arranged in rather irregular diagonal rows with about 12 zooecia in each; the apertures are surrounded by well-developed peristomes where they are well preserved, and some zooecia also show faint lunaria where about one-third of the circumference is curved to a slightly shorter radius. The zooecia are slightly oval, about 0·19 to 0·24 mm. long and 0·14 to 0·22 mm. wide; about 5 occur in 3 mm. longitudinally, and from 25 to 34 occur in a field of 7 sq. mm. The surface is weathered and between the apertures it is smooth, and a few rather widely separated hexagonellid ridges are shown; these are best shown near the lateral edges, where the surface is less weathered, but it is not possible to see how well developed these ridges were originally. The margins of the branches are not sharp; they are bordered by a narrow non-poriferous area, which is extended inwards for a short distance at the origin of each branch and lobe, and they are marked by a faint ridge formed by the edges of the mesial lamina. The base of the colony is not shown.

The zooecia are tubular, arising from each side of a distinct mesial lamina, and curving upwards to meet the surface at an angle of about 65° measured in the direction of growth. No diaphragms occur, but several zooecia are closed at the surface by a thin plate. Fairly fine vesicular tissue separates the zooecia near the mesial lamina, but about half-way to the surface this is replaced by dense tissue. In some sections of the holotype there is evidence of a second and third period of growth, with a recurrence of vesicular tissue and the development of new zooecia near the surface.

This species is a very much coarser form than *Hexagonella dendroidea* (Hudleston) 1883, from the Gascoyne River district.

HEXAGONELLA DENSA, n. sp. Pl. iv, fig. 2; Text-figs. 21–22*a*.

Horizon and locality: Lowest fossil horizon of the Barrabiddy Anticline, Barrabiddy shale series, about 3,500′ feet below base of Wandagee Series, 20 chs. south of Barrabiddy Dam, Wandagee Station. (Same locality as *Pseudoschistoceras simile* Teichert, 1944.) Coll. Teichert and party.

Holotype: 22131, Univ. W. Aust. Colln.

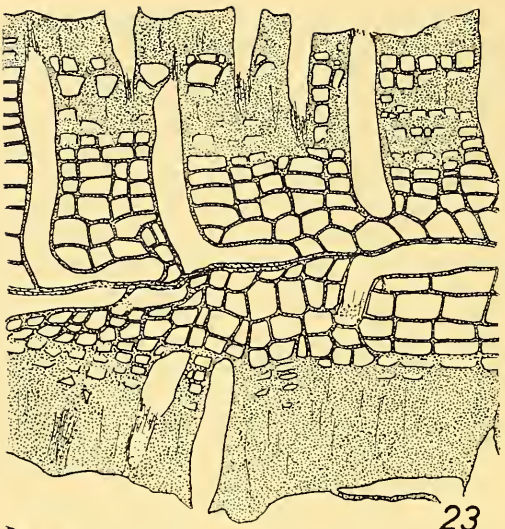
Broad, frond-like Hexagonella, *with large maculae composed of vesicles and dense tissue; zooecia small, sometimes with faint lunaria; diaphragms not numerous; interzooecial spaces filled by fine vesicles and dense tissue.*

The zoarium forms a broad, flattened bifoliate frond; the size of the holotype, which is an incomplete specimen, is 6 × 4·7 cm., and it is about 1 cm. thick at its thickest point. The surface is rather weathered and is marked by large, oval, solid maculae, which are made prominent by the weathering of the surfaces surrounding them; the centres of the maculae are spaced from 5 to 11 mm., generally about 8 mm. apart, and they are from 2 × 2·5 to 4 × 3 mm. in size; they are arranged, more or less regularly, in intersecting

Text-figs. 17-18*a*.—*Hexagonella plana*, n. sp. Thin sections of the holotype, × 20. 17. Vertical section. 18. Tangential section, cut in the outer part of the zoarium, with the spaces between the zooecia and the macula occupied by both dense tissue and vesicles. 18*a*. Tangential section, close to the centre of the zoarium, with the zooecia separated by vesicles. (Slides 41181, 41182, 41183, Univ. W. Aust. Colln.)

Text-figs. 19-20*a*.—*Hexagonella bifida*, n. sp. Thin sections of the holotype, × 20. 19. Vertical section. 20. Tangential section, cut in the outer part of the zoarium. 20*a*. Tangential section cut near the centre. (Slides 41194, 41195, 41196, Univ. W. Aust. Colln.)

Text-figs. 21-22*a*.—*Hexagonella densa*, n. sp. Thin sections of the holotype, × 20. 21. Transverse section. 22. Tangential section cut in the outer part of the zoarium. 22*a*. Tangential section cut near the centre. (Slides 41199, 41200, 41201, Univ. W. Aust. Colln.)



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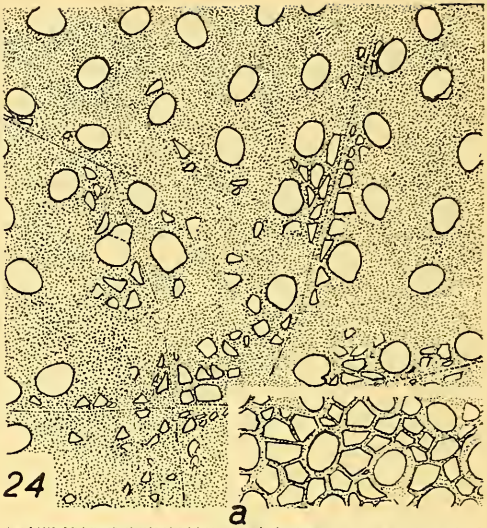

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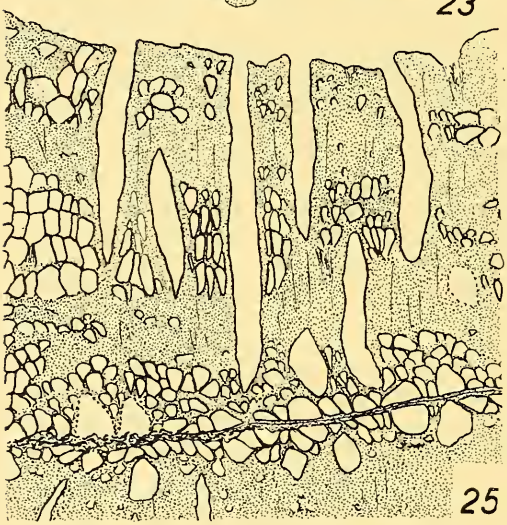

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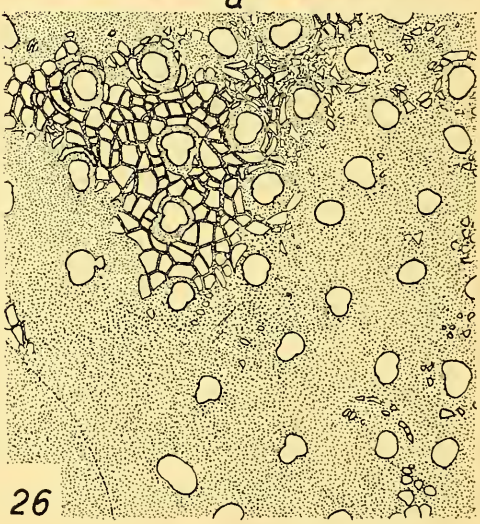

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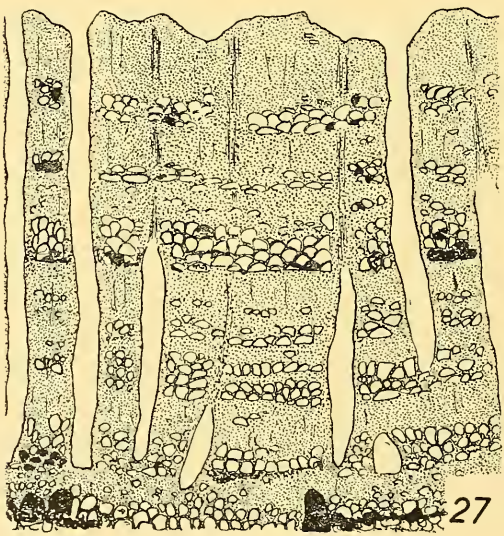

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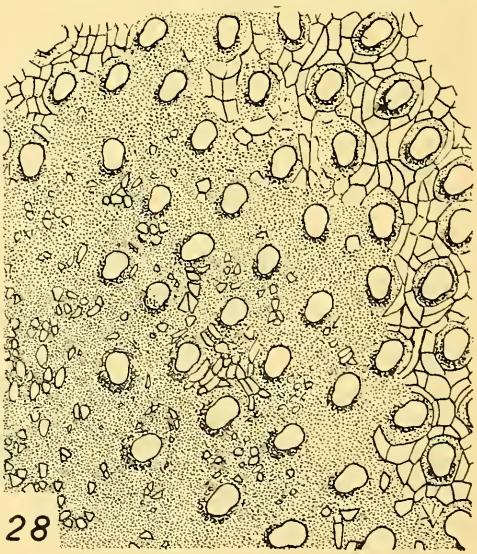


28

rows. The surface between the apertures is solid, and no hexagonellid ridges are now shown on it, although a few are shown in sections cut close to the surface.

The zooecia are tubular and are horizontal for only a short distance—about 0·8 mm.—on each side of the mesial lamina; they then bend sharply and meet the surface at almost a right angle. In a few tubes, especially in the slightly enlarged ones adjacent to the maculae, about one-third of the wall is curved to form a slight lunarium, which is rather thickened in some tubes. The tubes are usually about 0·25 × 0·2–0·24 mm. in diameter. One or two thin, slightly concave diaphragms occur in each tube. There are 20 to 25 zooecia in 7 sq. mm., and the distance between the centres of adjacent tubes is 0·48 to 0·68 mm. The maculae and interzooecial spaces are solid at the surface, but are filled by vesicular tissue near the centre, and this vesicular tissue replaces the dense tissue between the zooecia and in the maculae at intervals throughout the zoarium. The vesicles are thick walled, angular in transverse section near the centre, and elongate-oval close to the surface, and they are flattened on their lower and curved on their upper surfaces in vertical section. Near the centre, 8 to 11 vesicles surround each zooecium, but they are coarser closer to the surface, with about 6 around each tube; one to three rows of vesicles occur between adjacent tubes. The mesial lamina is thin, with rather coarse medial tubuli.

HEXAGONELLA NALBIA, n. sp. Text-figs. 27, 28.

Horizon and locality: Middle part (approx. zones 7–8) of Linoproductus Stage of the Wandagee Series, Nalbia Paddock, about ¼ mile east of where the road from Wandagee Woolshed to Middalya passes through the fence between Mungadan and Nalbia Paddocks. Coll. E. de C. Clarke and J. Lord.

Holotype: 22133, Univ. W. Aust. Colln.

Broad, frond-like Hexagonella, *with large, closely spaced maculae and prominent hexagonellid ridges: zooecia small, closely spaced; lunaria slight; diaphragms very rare; interzooecial spaces and maculae occupied by fine vesicles and dense tissue.*

The zoarium is a rather thick, flattened, bifoliate frond, the larger specimen, the holotype, measuring 3·5 × 3·0 cm., and about 0·8 cm. thick. The maculae are large, prominent, numerous, and irregularly and closely spaced, and are very irregular in shape; they are very slightly depressed, and measure 0·2 × 0·2 to 0·4 × 0·3 mm., their centres being spaced 3·5 to 6 mm. apart. The zooecial apertures are 0·21 to 0·24 × 0·14 to 0·21 mm. in diameter, the zooecia close to a macula being slightly larger; 32 to 38 zooecia occur in 7 sq. mm. Thin, closely spaced and irregularly grouped hexagonellid ridges occur on the surface.

In section, the zooecia are horizontal and wedge-shaped on each side of the mesial lamina, but they rapidly bend and pass upwards vertically to meet the surface at right angles; slight lunaria, occupying about one-half of the circumference and slightly indenting the tubes, are shown in some zooecia; very thin diaphragms occur only very rarely. The vesicular tissue which separates the zooecia in the central part of the zoarium consists of rather flattened, irregular vesicles, developed in zones separated by dense tissue throughout the zoarium; the dense tissue becomes progressively more important as the surface is approached; the vesicles occur generally in two or three

Text-figs. 23-24*a*.—*Hexagonella lineata*, n. sp. Thin sections of the holotype, × 20. 23. Vertical section. 24. Tangential section, cut near the surface of the zoarium, showing part of a macula and some of the fine hexagonellid ridges, which are shown in sections only near the surface, and the zooecia separated by a few vesicles and by dense tissue. 24*a*. Tangential section cut deeper within the zoarium, in the zone in which the zooecia are separated by coarse, thick walled vesicles. (Slides AM 3583, 3584, Aust. Mus. Colln.)

Text-figs. 25-26.—*Hexagonella undulata*, n. sp. Thin sections of the holotype, × 20. 25. Transverse section. 26. Tangential section, cut through a macula crossed by an hexagonellid ridge in the lower left-hand corner, and passing through the zone in which the zooecia are separated mainly by dense tissue to that in which coarse vesicles are developed. (Slides 41188, 41189, Univ. W. Aust. Colln.)

Text-figs. 27-28.—*Hexagonella nalbia*, n. sp. Thin sections of the holotype, × 20. 27. Transverse section; the mesial lamina, along which the zoarium has been shattered, is at the level of the zooecia infilled by dark material near the base of the figure. 28. Tangential section. (Slides 41197, 41198, Univ. W. Aust. Colln.)

rows between the zooecia, and from 6 to 8 vesicles surround each tube. The hexagonellid ridges are seen in sections cut near the surface as fine light lines separated by a row of darker granules.

HEXAGONELLA UNDULATA, n. sp. Text-figs. 25, 26.

Horizon and locality: Lower part (zone 8) of Linoproductus Stage of the Wandagee Series; Coolkilya Paddock, 6 chs. north of a point 96 chs. west (along fence) of the south-east corner ("Quinnanie Corner") of Paddock. Coll. C. Teichert.

Holotype: 22128, Univ. W. Aust. Colln.

Broad, frond-like Hexagonella, *maculae large, slightly depressed; hexagonellid ridges well developed; zooecia small, with distinct thickened lunaria; no diaphragms; vesicular tissue coarse near the centre, finer and partly replaced by dense tissue near the surface.*

The zoarium is thin and bifoliate, the holotype is about 4 × 4 cm. and up to about 6 mm., but generally about 4 mm., thick. Large, slightly depressed, irregularly shaped, solid maculae, 3 × 1·5 to 2 mm. in diameter, and spaced with their centres 5 to 9 mm. apart, occur irregularly on the surface. Fine hexagonellid ridges are well developed, but do not form any regular pattern on the surface. The zooecial apertures are usually much enlarged by weathering at the surface, but in section they are oval to bipetaloid, usually with distinct thickened lunaria, which occupy about one-half of the circumference; their measurements are: a, 0·21–0·27 mm.; b, 0·17–0·22 mm.; c, 0·1–0·13 mm.; d, 0·13–0·16 mm. From 25 to 30 zooecia occur in 7 sq. mm. No diaphragms occur. Vesicular tissue between the zooecia is subordinate to dense tissue, but numerous angular vesicles, 8 to 10 surrounding each tube, occur between the zooecia in about two to six rows in the central part of the zoarium, and zones of vesicular tissue, usually finer than that at the centre, occur throughout the zoarium.

This species resembles *H. nalbia*, n. sp., which occurs on the same horizon, in its surface characters, except in the thickness of the zoarium, but is differentiated by the spacing of the tubes, and internally by the greater development of lunaria, and by the type of vesicular tissue.

HEXAGONELLA BIFIDA, n. sp. Text-figs. 19–20*a*.

Horizon and locality: Nooncanbah Series, just north of Hill C, Grant Ra., West Kimberley Division.

Holotype: 22132, Univ. W. Aust. Colln.

Hexagonella *with a broad, parallel-sided frond; zooecia without lunaria; diaphragms rare; interzooecial spaces and maculae occupied by fairly coarse vesicles, replaced by dense tissue near the surface.*

The zoarium is a broad, parallel-sided, flattened, bifurcating frond; the width of fully-developed branches is about 2·3 cm. to 2·7 cm., and the thickness of the branches about 2 to 3·5 mm.; two bifurcations of the frond, about 4·5 cm. apart, are shown in the holotype. Small, solid, oval to rounded maculae, up to about 4 mm. long and 1·5 to 3 mm. wide, occur irregularly but usually fairly closely spaced on the surface; they are level with the rest of the surface. No hexagonellid ridges are shown. No lunaria are developed, and the zooecial apertures are oval, 0·21 × 0·17 to 0·24 × 0·22 mm. in diameter; the zooecia bordering the maculae are usually slightly larger. The apertures are surrounded by distinct peristomes; from 22 to 26 apertures occur in 7 sq. mm. The zooecia are tubular, and are recumbent for a comparatively long distance (about 1 mm.) on each side of the thin, flexuous mesial lamina; they bend at varying angles, fairly sharply, to the surface. Slightly concave diaphragms occur in some of the tubes. The zooecia are separated by alternating layers of vesicular and dense tissue of varying thicknesses. The vesicles are coarse near the centre, and more flattened near the surface, where they are long and narrow in tangential section, with three to five rows separating adjacent zooecia.

HEXAGONELLA LINEATA, n. sp. Plate iv, fig. 4; Text-figs. 23, 24.

Horizon and locality: Nooncanbah Series, Mt. Marmion. Coll. H. Basedow.

Holotype: F 17567, Aust. Mus. Colln.

Broad, frond-like Hexagonella, *with numerous regularly placed maculae, and strong hexagonellid ridges; zooecia small, lunaria distinct at surface, rarely shown in sections; diaphragms rare; vesicular tissue very coarse, replaced by dense tissue near the surface.*

The zoarium is bifoliate, and forms thin, broad, folded fronds, up to 3·5 × 2·5 cm. in size; the holotype is from about 3 to 4 mm. thick, but a second specimen (F 17569, Aust. Mus. Colln.), from the same locality, is only 1 to 2·5 mm. thick; apart from this difference in thickness, these specimens are identical in surface and internal structure. The edges of the frond are fairly sharp to rounded. The surface is divided up into irregular polygonal areas, 1·5 to 7·5 mm. across, by thin, slightly raised ridges, which are rapidly removed by weathering; small, oblong, solid maculae, about 1·5 mm. wide and 2·5 to 3·5 mm. long, occur usually where three or more ridges join; the maculae are arranged in intersecting rows, and are spaced 3 to 7 mm. apart, being rather further apart in the direction of their longer diameters than at right angles to them. The surface between the apertures is solid and coarsely granular where it is well preserved, but slight weathering exposes the vesicles which separate the zooecia internally. The zooecial apertures radiate from the maculae and are oval, and are surrounded by slight peristomes, separated and raised at one end to form distinct lunaria occupying about one-third of the circumference of each aperture, and curved to a very slightly shorter radius than the rest of the tube wall; in sections this lunarium can be seen only in a very occasional tube, and the tubes are oval and rather thick walled, 0·21 to 0·25 mm. long by 0·16 to 0·21 mm. wide. The tubes are horizontal for about 0·8 mm. on each side of the thin mesial lamina, and then bend at varying angles, but usually sharply, towards the surface; about 33 to 36 tubes occur in 7 sq. mm. Diaphragms occur only in a few tubes. The dense tissue which separates the zooecia at the surface forms a layer of varying thickness, but usually 0·3 to 0·65 mm. thick, and within this the spaces between the zooecia, and the maculae, are occupied by vesicular tissue; the vesicles are very coarse and thin walled near the centre of the zoarium, but become flatter and thicker walled as the dense tissue is approached; they are angular in transverse section, and occur in one or two, rarely three, rows between the zooecia, with 6 to 9 vesicles around each tube.

Hexagonella plana, n. sp. Text-figs. 17–18*a*.

Horizon and locality: Highest fossil horizon of Nooncanbah Series, south-east side of Mt. Marmion, near foot of slope. Coll. C. Teichert.

Holotype: 22125, Univ. W. Aust. Colln.

Broad, frond-like Hexagonella, *with regularly arranged, small, slightly depressed, solid maculae; zooecia small, lunaria poorly developed; diaphragms fairly numerous; vesicular tissue fine, replaced by dense tissue near the surface.*

The zoarium is a broad, flattened bifoliate frond; along one edge the surface is raised to form small fronds at right angles to the main one; the size of the holotype, which is an incomplete specimen, is 3·5 × 4·5 cm., and its thickness is up to 8 mm. Small, solid, slightly depressed maculae occur in intersecting rows on the surface; they are about 1·5 mm. in diameter, and their centres are 4·5 to 6 mm. apart. The surface between the apertures is solid; the zooecial apertures are oval, and in section poorly-developed lunaria, occupying rather more than one-half of the circumference, are shown in some of the tubes; measurements of zooecia in sections are: a, 0·21–0·25 mm.; b, 0·16–0·21 mm.; c, 0·13–0·14 mm.; d, 0·16–0·19 mm.; 26 to 32 zooecia occur in 7 sq. mm., the distance between the centres of adjacent zooecia being 0·41 to 0·55 mm. The zooecia are horizontal for a short distance on each side of the mesial lamina, and then bend sharply until they are almost vertical. From one to five rather thick, slightly concave, irregularly spaced diaphragms occur in each tube. The zooecia are separated near the centre of the zoarium by thick walled, flattened vesicles; 9 to 11 vesicles surround each tube, and two to three rows occur between the zooecia; dense tissue intermittently replaces the vesicles, and almost completely replaces them near the surface. The mesial lamina is thin and fairly straight, with fine median tubuli. No hexagonellid ridges are developed.

Order CRYPTOSTOMATA Vine.

Family SULCORETEPORIDAE Bassler.

Genus SULCORETEPORA d'Orbigny, 1849.

Sulcoretepora d'Orbigny, 1849, 501; *Sulcoretepora* d'Orbigny, McNair, 1937, 137.

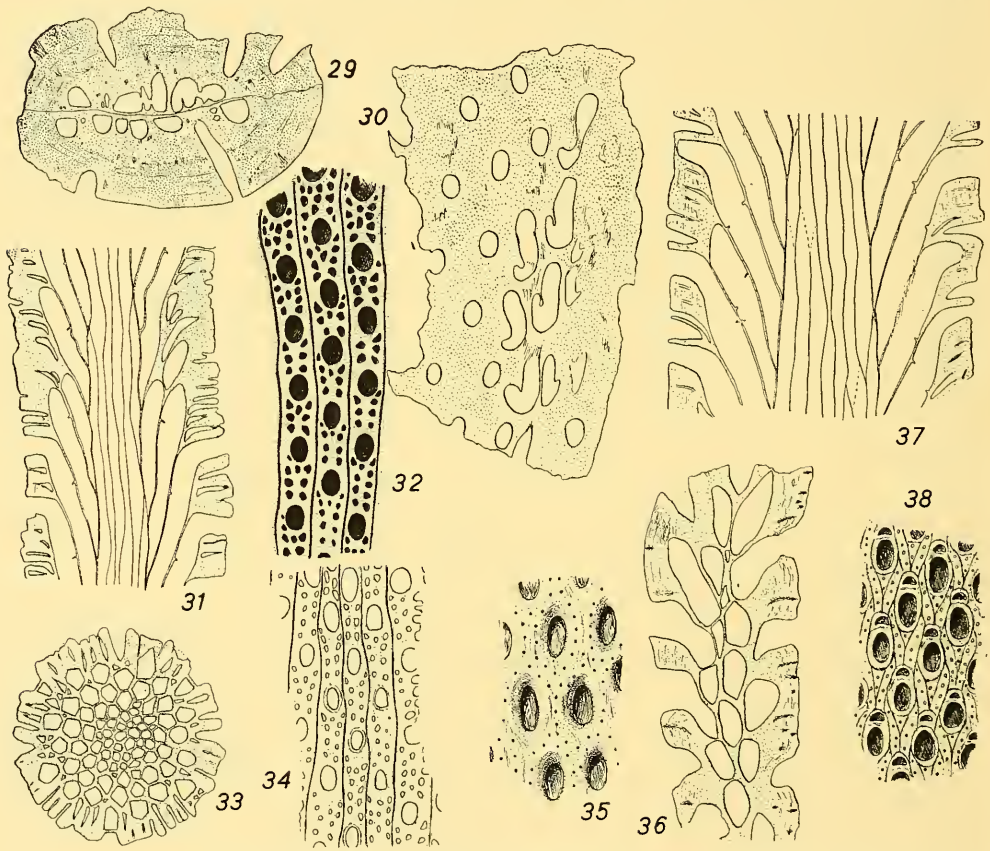
"SULCORETEPORA" MERIDIANUS (Etheridge) 1926. Pl. iv, fig. 6; Text-figs. 29, 30.

Sulcoretepora (?) *meridianus* Etheridge, 1926, in Bretnall, 19, Pl. i, fig. 9; [?] *Sulcoretepora meridianus* Etheridge, Hosking, 1931, 15.

Horizon and locality: Nooncanbah Series, Mt. Marmion (see p. 142).

Holotype: Specimen 15 on 10930*a*, W. Aust. Geol. Surv. Colln.

Zoarium a bifoliate, flattened stipe; zooecial apertures oval, in six longitudinal rows, increasing to eight before bifurcation, and in regular diagonal rows; zooecia with long



Text-figs. 29-30.—*"Sulcoretepora" meridianus* (Etheridge). Thin sections of specimen 15 on 10930*b*, W. Aust. G.S. Colln., × 20. 29. Transverse section. 30. Oblique tangential section, showing along the centre the hook-shaped form of the zooecia in sections cut parallel to the surface.

Text-figs. 31-34.—*Streblotrypa marmionensis* Etheridge. 31, 33, 34. Thin sections of specimens (Slides 41205-7, Univ. W. Aust. Colln.) from Mt. Marmion, × 20. 31. Vertical section, showing the small hemisepta. 33. Transverse section. 34. Tangential section. 32. Surface of a specimen from Mt. Marmion (on 10930, W. Aust., G.S. Colln.), × 20, showing a great deal of variation in the number and arrangement of the mesopore pits below the apertures.

Text-figs. 35-36.—*Rhombopora multigranulata* Bretnall. 35. Surface of the holotype, × 20, to show the development of the acanthopores. 36. Vertical section of a paratype (3 on 10930*a*, W. Aust. G.S. Colln., from Mt. Marmion).

Text-figs. 37-38.—*Streblotrypa etheridgei* Bretnall. 37. Vertical section of a specimen from Mt. Marmion (on 10930, W. Aust. G.S. Colln.), × 20, showing both inferior and superior hemisepta in the zooecia. 38. Surface of the holotype, × 20.

vestibules; recumbent part of zooecia hook-shaped; interspaces occupied by dense tissue with a few small vesicles.

The zoarium is bifoliate, consisting of a flattened stipe about 1·74 to 1·95 mm. in width and about 0·95 to 1·1 mm. in thickness at its thickest part. The holotype is about 2 cm. long, and in this distance, three branches are given off at an angle of about 30° on one side of the stem, successive branches being 9·5 to 11 mm. apart; the specimen cannot be freed from the matrix sufficiently to show whether branches are given off alternately with these on the other side of the zoarium, but the arrangements of the apertures suggests that they are. Another specimen is 14 mm. long, and does not branch in that distance. The branches have a non-celluliferous margin about 0·25 mm. wide on each side, and a slight ridge along each edge marks the position of the ends of the mesial lamina; the edges are not very sharp, and one is slightly more rounded than the other. The apertures are oval, 0·16 × 0·11 mm. in diameter; the distance between the centres of successive apertures is 0·46 to 0·57 mm. on the parts of the branches where they are regularly arranged, and 20 to 21 occur in 10 mm. The peristomes are slight at the anterior ends of the apertures, but are raised at the posterior ends so that they form a slight hood over the aperture, but this part is not curved to a shorter radius than the rest of the peristome. There are normally six fairly well defined longitudinal rows of zooecia, increasing to about eight before bifurcation; the apertures are also arranged in diagonal rows. The surface between the rows of apertures is solid and finely granular.

Internally, the central part of the zoarium containing the cells comprises only one-quarter of its total width, the vestibules being three times as long as the depth of the cells. The interzooecial spaces are occupied by dense tissue, with a few small vesicles, developed in the inner part of the vestibular area and between the cells. The recumbent part of the zooecia appears hook-shaped in sections cut parallel to the surface (Text-fig. 30), and the zooecia are not separated by longitudinal plates; the mesial lamina is thin.

The internal structure, and especially the hook-shaped zooecia, in this species clearly separate it from *Sulcoretepora*, which it closely resembles externally. As only a limited amount of material, in which the internal structure was not best preserved, was available for the revision of this species, and since a number of new species resembling *Sulcoretepora* externally, and with different types of internal structure, occur in the Permian of Western Australia, definition of a new family and genus for the group to which "*S.*" *meridianus* belongs is left until all these *Sulcoretepora*-like forms are studied together and described; but because it would not be possible to recognize "*S.*" *meridianus* from the original description and figure, it is revised here to complete the description of the new species whose descriptions were published by Bretnall.

Hosking (1931, 15) has recorded this species from the Callytharra Series of the Wooramel River district, but did not figure specimens from this locality; I have been unable to find any specimens of "*S.*" *meridianus* in the material from the Callytharra available to me.

Genus Goniocladia Etheridge, 1876.

Goniocladia Etheridge, 1876, 522; *Goniocladia* Etheridge, Bassler, 1929, 88; Moore, 1929*b*, 154. *Homonym*: *Carinella* Etheridge, 1873.

Genotype: *Carinella cellulifera* Etheridge, 1873.

Range: Carboniferous to Permian.

Zoarium infundibuliform, celluliferous on the outer surface, composed of anastomosing branches; branches bifoliate, dividing in a plane at right angles to the mesial lamina, and enclosing polygonal fenestrules, whose size and shape are characteristic for each species; internal structure as in Ramipora.

Goniocladia timorensis Bassler, 1929. Pl. v, fig. 8.

Goniocladia timorensis Bassler, 1929, 89, Pl. ccxlvii (23), figs. 8–15.

Two specimens (2757*e*, *f*, Univ. W. Aust. Colln.), agreeing with the description and figures given for this species by Bassler, occur in material from the Nooncanbah Series,

9 miles east-north-east from Trig. Stn. G 2, St. George's Ra.; the holotype of the species is from the Basleo Beds at Basleo, Timor. In the specimen figured here, the base of the colony, giving off three strong branches which divide to give rise to the fenestrate colony, is preserved.

Although other species of *Goniocladia* occur at this and other localities in the Nooncanbah Series—there is a second specimen, of a coarser species, on the same piece of limestone as the figured specimen—there is not sufficient material available at present for their description.

Family Fenestrellinidae Bassler.

Genus Fenestrellina d'Orbigny, 1849.

Two species of *Fenestrellina* which were originally described from the Wayland Shale of the Graham Formation (Upper Pennsylvanian) of North-Central Texas, were recorded (as *Fenestella pectinis* Moore, 1929—Commonw. Palaeont. Colln., F 793–794—and *F. spinulifera* Moore, 1929—Commonw. Palaeont. Colln., F 782–792) by Raggatt (1936, 128) from the Callytharra Series at Callytharra Springs on the Wooramel River. These specimens have been re-examined and are described here. Identity with the American species is not confirmed, the specimens previously recorded as *Fenestella pectinis* being here identified as *Fenestrellina horolgia* (Bretnall) and *Minilya* sp. cf. *M. duplaris* Crockford, and those recorded as *Fenestella spinulifera* Moore are, with additional specimens, described as *Fenestrellina affluensa* (Bretnall), and *F. chapmani*, n. sp., *F. sparsigemmata*, n. sp., *F. alia*, n. sp., and *Minilya amplia*, n. sp.

Fenestrellina horologia (Bretnall), 1926.

Fenestella pectinis Moore (*partim*), Chapman, in Raggatt, 1936, 128; [*non*] *F. pectinis* Moore, 1929, 18, Pl. ii, figs. 8–10; *Fenestella horologia* Bretnall, 1926, 15, Pl. i, fig. 6; *Fenestrellina horologia* (Bretnall), Crockford, 1944, 189, Pl. i, fig. 1, Pl. ii, fig. A.

Horizon and locality: Callytharra Stage, west of Callytharra, Wooramel R.

Specimen: F 793, Commonw. Palaeont. Colln.

This specimen is a coarser form, with more widely spaced zooecia and nodes, than *Fenestrellina pectinis*, and should be referred to *F. horologia*.

Fenestrellina affluensa (Bretnall), 1926. Pl. iv, fig. 10.

Fenestella spinulifera Moore, (*partim*), Chapman, in Raggatt, 1936, 128; [*non*] *F. spinulifera* Moore, 1929, 20, Pl. iii, figs. 3–5; *Fenestella affluensa* Bretnall, 1926, 16, Pl. i, fig. 8; *Fenestrellina affluensa* (Bretnall), Crockford, 1944, 188, Pl. i, fig. 6.

Horizon and locality: Callytharra Stage, west of Callytharra, Wooramel R.

Specimens: F 782–784, Commonw. Palaeont. Colln.

These three specimens of this species are more heavily calcified and are also better preserved than the holotype, which is from the Gascoyne River district (probably from the Callytharra Series, see p. 142). The heavy calcification makes for some differences in the appearance of the specimens—in the broader and thicker branches, and the wider dissepiments and shorter fenestrules—but the spacing and arrangement of the nodes and apertures, and of the branches and fenestrules, are as in the holotype.

Fenestrellina chapmani, n. sp. Pl. iv, fig. 5.

Fenestella spinulifera Moore, (*partim*), Chapman, in Raggatt, 1936, 128; [*non*] *F. spinulifera* Moore, 1929, 20, Pl. iii, figs. 3–5.

Horizon and locality: Callytharra Series, west of Callytharra (holotype), and below Callytharra, Wooramel R.

Specimens: F 788–91, 801, Commonw. Palaeont. Colln. *Holotype*: F 788.

Very coarse Fenestrellina, *with large, widely spaced apertures, and very large, distant nodes.*

The zoarium is fenestrate; the branches are coarse, 0·54 to 0·76 mm. in width, with 8 to 9 in 10 mm. There is a slight median carina, with large, blunt nodes, developed from 0·73 to 2·1 mm. (generally between 0·85 and 1·4 mm.) apart; these nodes attain a height of up to 0·4 mm., and are up to 0·33 mm. in diameter at the top. The zooecia are

in two rows, increasing to three immediately before bifurcation; the apertures are large, 0·16 mm. in diameter, and are surrounded by thin, slightly raised peristomes. The distance between the centres of successive apertures is 0·36 to 0·5 mm., and there are 4 to 8, usually 5, apertures to a fenestrule, with about 25 in 10 mm. The fenestrules are 1·17 to 2·46 mm. in length and 0·54 to 0·95 mm. wide; there are 4 to 5 fenestrules in 10 mm. vertically. The dissepiments are 0·33 to 0·68 mm. wide. The whole of the celluliferous surface is covered by very fine granules and striae. On the reverse surface both branches and dissepiments are finely granular, with occasional coarse granules developed: the thickness of the branches is 0·65 to 1·0 mm.

Fenestrellina sparsigemmata, n. sp. Pl. iv, fig. 9.

Fenestella spinulifera Moore, (*partim*), Chapman, 1936, 128; [*non*] *F. spinulifera* Moore, 1929, 20, Pl. iii, figs. 3–5.

Horizon and locality: Callytharra Series, west of Callytharra, Wooramel R.

Holotype: F 785, Commonw. Palaeont. Colln.

Coarse Fenestrellina, *with rounded fenestrules, 3 to 4 zooecia to a fenestrule, and large, very widely spaced nodes.*

The zoarium is fenestrate; the branches are broad, 0·6 to 0·68 mm. in width, with 10 to 10·5 in 10 mm. There is a slight median carina, with a single row of large, very widely spaced, blunt nodes, placed from 0·97 to 1·3 mm. apart; the nodes reach a diameter of up to 0·33 × 0·27 mm. at the top and are up to 0·16 mm. high, but many of the nodes are much smaller. The zooecial apertures are in two rows, increasing to three just before bifurcation; they are round, 0·17 mm. in diameter; the distance between the centres of successive apertures is from 0·36 to 0·43 mm., and there are 3 to 4 apertures to a fenestrule, with about 25 in 10 mm. The fenestrules are rounded, about 0·72 mm. long and 0·29 to 0·48 mm. wide, with 7 to 7·5 in 10 mm.; the dissepiments are 0·72 to 0·76 mm. wide. On the reverse surface, both branches and dissepiments are rounded and smooth, and are of about the same thickness.

This species is differentiated from *Fenestrellina affluensa* (Bretnall) by the much wider spacing of its nodes.

Fenestrellina alia, n. sp. Pl. iv, fig. 8.

Fenestella spinulifera Moore, (*partim*), Chapman, 1936, 128; [*non*] *F. spinulifera* Moore, 1929, 20, Pl. iii, figs. 3–5.

Horizon and locality: Callytharra Series, west of Callytharra, Wooramel R.

Specimens: F 786–7, Commonw. Palaenot. Colln. *Holotype*: F 786.

Coarse Fenestrellina, *with 7·5 to 8 fenestrules in 10 mm., and 4 zooecia to a fenestrule; nodes very rarely developed.*

The zoarium is fenestrate; the branches are broad, 0·54 to 0·62 mm. wide, with 10 to 11 in 10 mm.; the zooecia are in two rows, separated by a slight, rounded median carina, on which small nodes are developed only very occasionally; the distance between the centres of successive apertures is 0·3 to 0·4 mm., and there are usually 4, rarely 3 or 5, zooecia to a fenestrule, with about 29 in 10 mm.; the apertures are small and rounded, 0·11 mm. in diameter, and are surrounded by slight peristomes. The fenestrules are oval, 0·62 to 1·1 mm. long and 0·22 to 0·5 mm. wide, with 7·5 to 8 in 10 mm.; the dissepiments are 0·43 to 0·62 mm. wide. On the reverse surface both branches and dissepiments are evenly rounded and smooth, and they are of about the same thickness, about 0·6 to 0·87 mm.

Genus Minilya Crockford, 1944.

Minilya amplia, n. sp. Pl. iv, fig. 7.

Fenestella spinulifera Moore, (*partim*), Chapman, 1936, 128; [*non*] *F. spinulifera* Moore, 1929, 20, Pl. iii, figs. 3–5.

Horizon and locality: Callytharra Series, west of Callytharra, Wooramel R.

Holotype: F 792, Commonw. Palaeont. Colln.

Coarse Minilya, *with 7 fenestrules and 12 branches in 10 mm., 3 zooecia to a fenestrule, small nodes placed in two rows on the carina.*

The zoarium is fenestrate; the branches are about 0·48 mm. wide, with 12 in 10 mm.; the zooecia are in two rows, separated by a broad and poorly defined median carina, which bears two rows of small nodes placed 0·19 to 0·22 mm. apart, one node being placed adjacent to each zooecial aperture. The apertures are small and rounded, 0·11 mm. in diameter, and are surrounded by thin, high peristomes; the distance between the centres of successive apertures is 0·35 to 0·43 mm., with 3, very rarely 4, apertures to a fenestrule, and about 25·5 in 10 mm. The fenestrules are oval, but are very much indented at the sides by the projection into them of the zooecial apertures; they are 0·86 to 1·17 mm. (generally less than 0·95 mm.) long, 7 occurring in 10 mm., and are 0·31 to 0·36 mm. wide; the dissepiments are 0·28 to 0·36 mm. wide. On the reverse surface both branches and dissepiments are smooth and evenly rounded, and they are of about the same thickness.

This species most closely resembles *M. kukaensis* (Bassler), 1929, from the Amarassi Beds of Timor, but differs in having fewer zooecia to a fenestrule, and in the wider spacing of its apertures.

MINILYA sp. cf. M. DUPLARIS Crockford, 1944.

Fenestella pectinis Moore, (*partim*), Chapman, in Raggatt, 1936, 128; [*non*] *F. pectinis* Moore, 1929, 18, Pl. ii, figs. 8–10; cf. *Minilya duplaris* Crockford, 1944, 173, Pl. i, figs. 5, 7, Text-fig. 1 C, D.

Specimen: F 794, Commonw. Palaeont. Colln., from the Callytharra Series, west of Callytharra, Wooramel R.

This specimen is separated by the two rows of nodes on its carina from the other specimen identified previously with *Fenestella pectinis*. It is a very small fragment, two fenestrules long, and resembles *Minilya duplaris* in the arrangement of its zooecia and nodes; the apertures in this specimen, and in several similar fragments sorted from loose material from the same locality, are, however, pyriform, instead of rounded and stellate, and the branches are narrower, the fenestrules slightly longer, and the zooecia and nodes rather more widely spaced than in typical *M. duplaris*, to which species it can be most closely compared; although the differences shown appear to be constant in the specimens available, the material is insufficient for description.

Genus PROTORETEPORA de Koninck, 1878.

PROTORETEPORA AMPLA (Lonsdale), 1844.

Fenestella ampla Lonsdale, 1844, 163; *Protoretepora ampla* (Lonsdale), Crockford, 1941, 406, Pl. xix, fig. 4.

A single specimen, 22320, Univ. W. Aust. Colln., from the Nooncanbah Series, scarp 2 miles east of Christmas Ck. Homestead, West Kimberley district, belongs to the same species as specimens from Bundanoon and Rylstone in New South Wales (Crockford, 1941, 406; 1943, 266) referred to *P. ampla* (Lonsdale).

Family ACANTHOCLADIIDAE Zittel.

In the pinnate forms belonging to this family, the most important characters in the determination of species are: (1) the arrangement of the zooecial apertures, their distance apart and their arrangement in relation to lateral branches, (2) the spacing of the lateral branches, and to a less extent the angle at which they are given off, (3) the characters of the carina and the arrangement of the nodes (if present), (4) the arrangement of accessory pores, if present, (5) any special type of surface ornamentation, such as the replacement of the carina by a series of longitudinal ridges and furrows, (6) the shape of unweathered zooecial apertures—the apertures are very readily weathered and enlarged, and lose their distinctive shape, but the shape of perfect zooecial apertures is an important characteristic.

The width of both the midrib and the lateral branches, which may in turn be pinnate, are largely determined by their position in the colony, those near the base being very robust and often greatly thickened by deposits of granular calcium carbonate,

which may obliterate the apertures; these characters are, therefore, not of specific value.

Branching near the base of the colony apparently tends to be very irregular, and a number of small bases of *Pennniretepora* up to about 5 mm. high, which occurred in material from the Callytharra, could only be referred tentatively to any species on the characters and spacing of the zooecia and nodes.

Genus PENNIRETEPORA d'Orbigny, 1849.

Pennniretepora d'Orbigny, 1849, 501; *Pennniretepora* d'Orbigny, Bassler, 1934, 20, 165; [*non*] *Pennniretepora* d'Orbigny, 1850, 45; *Homonym*: *Acanthopora* Young and Young, 1875; *Synonyms*: *Glauconome* Auctt. (not Goldfuss, 1826), *Pinnatopora* Vine, 1884.

Genotype: *Retepora pluma* Phillips, 1827.

Range: Upper Silurian to Permian.

Zoarium pinnate, midrib and branches with two rows of zooecia, usually separated by a carina, with or without a single row of nodes; branches free; zooecia simple, rhomboidal.

Species of *Pennniretepora* are fairly abundant in the Callytharra, and several hundreds of fragments were separated from material weathered from the limey shales at two localities, west of Callytharra, and below Callytharra, on the Wooramel R. A few more complete specimens preserved on the surface of slabs of limestone and limey shales from these and other localities were used in the descriptions of the three species which are here named. One of these species was previously recorded from the Callytharra as *Pinnatopora trilineata* Meek var. *texana* Moore (Chapman, in Raggatt, 1936, 128). A number of other species were represented in the fragmentary material examined, but the specimens at present available are not good enough for descriptions of these species to be made. A small number of pinnate specimens show two distinct rows of nodes on the carina, paralleling the development of a similar group of species in the Fenestrellinidae.

In view of their abundance in the Callytharra and in the Permian Basleo Beds in Timor, it is surprising that no specimens at all of *Pennniretepora* have so far been found in material from the Wandagee and Nooncanbah Series.

PENNIRETEPORA TRIPOROSA, n. sp. Pl. v, fig. 4; Text-fig. 49.

Pinnatopora trilineata var. *texana* Moore, Chapman, in Raggatt, 1936, 128; [*non*] *Pinnatopora trilineata* Meek var. *texana* Moore, 1929*b*, 126, Pl. xv, figs. 6–9.

Horizon and locality: Callytharra Series, west of Callytharra (*holotype*) and below Callytharra (F 792, Commonw. Palaeont. Colln.), Wooramel R.; Well ↑ 20, Daurie Ck., Gascoyne R. district (on 2/2404B, W. Aust. G.S. Colln.).

Holotype: F 795, Commonw. Palaeont. Colln.

Fine Pennniretepora, *three zooecia between the origins of successive branches, slight carina with distant nodes.*

The zoarium is pinnate; the midrib is rather thin, 0·35 to 0·67 mm. wide, with alternating to almost opposite lateral branches, given off at an angle of 55° to 70°, and 0·27 to 0·43 mm. wide; the distance between the carinae of two successive branches on the same side of the midrib is 1·0 to 1·6 mm., and there are about 8 lateral branches on each side of the midrib in 10 mm. The zooecial apertures are in two rows on both the midrib and branches, and on the midrib there are three apertures between the points of origin of two successive branches. The apertures are pyriform, and when they are perfectly preserved nine short spines are shown projecting into each aperture; they are surrounded by thin, raised peristomes, and are up to 0·14 × 0·1 mm. in diameter. There are about 24 apertures in 10 mm. on the midrib, where the distance between the centres of successive apertures is 0·36 to 0·49 mm.; on the lateral branches the spacing is rather closer, their centres being 0·33 to 0·4 mm. apart, and about 26·5 apertures occur here in 10 mm. Both midrib and branches bear a slight median carina, on which small nodes are developed; on the midrib the observed spacing of these, in specimens from the type locality, was 0·8 mm. to more than 1·6 mm., and in specimens from west of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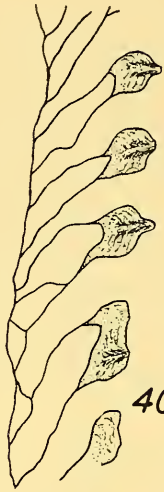
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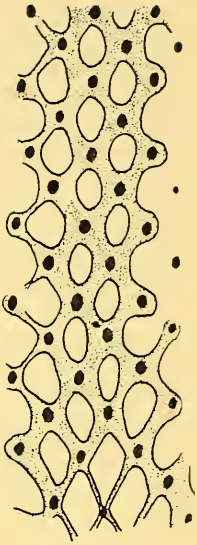


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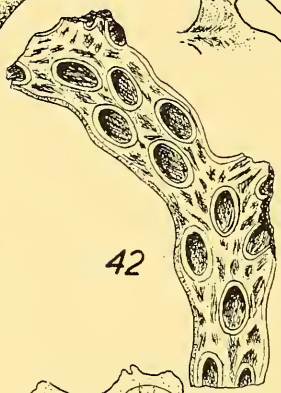
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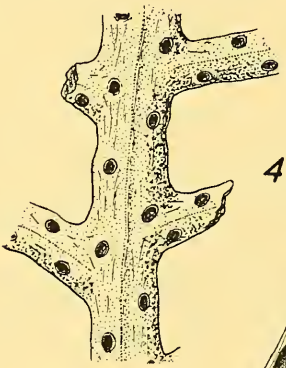
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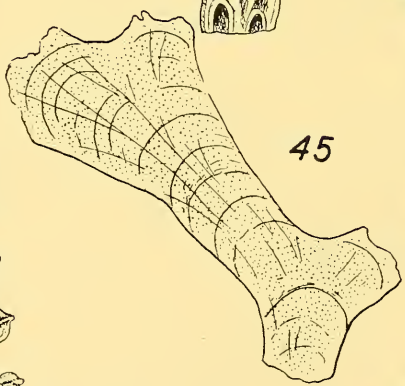
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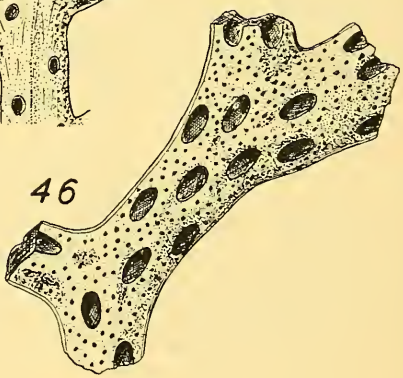
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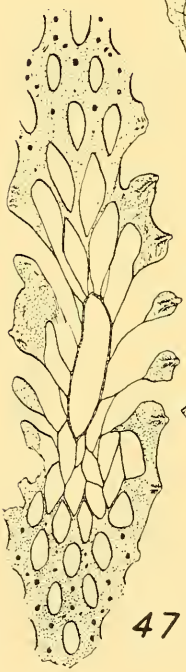
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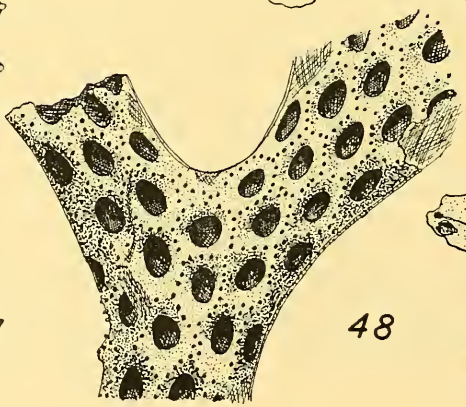
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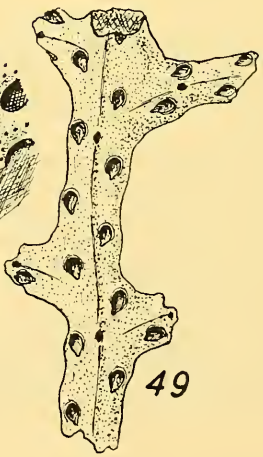
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Callytharra, in which the surface was better preserved, the spacing of the nodes was 0·6 to 2·1 mm., usually 0·95 to 1·6 mm., with an average of about 8·5 in 10 mm. The whole of the obverse surface is ornamented by oblique granular ridges and grooves about the apertures. On the reverse surface the midrib and branches are evenly rounded, and they are ornamented by granular longitudinal ridges and grooves.

This species from the Callytharra Stage differs from *Penniretepora trilineata* var. *texana* (Moore) in the much wider spacing of the pinnae and in the spacing of its apertures; the arrangement of the apertures is similar in the two species, but *P. triporosa* has only 24 apertures in 10 mm. compared with 31 to 32 in *P. trilineata texana*; the type of carina and the presence of nodes also differentiate *P. triporosa*.

PENNIRETEPORA GRANULATA, n. sp. Pl. v, fig. 9; Text-fig. 44.

Horizon and locality: Callytharra Series, below Callytharra (holotype) and west of Callytharra (F 797, Commonw. Palaeont. Colln.), Wooramel R.

Holotype: F 800, Commonw. Palaeont. Colln.

Fine Penniretepora, *with two zooecia between the origin of successive branches; slight carina marked by a row of fine granules, but without nodes.*

The zoarium is pinnate; the midrib is 0·3 to 0·8 mm., typically about 0·55 mm. wide, with lateral branches 0·21 to 0·4 mm. wide, given off at angles of 50° to 85°, the angle varying considerably in any one specimen; only one lateral branch was observed to be pinnate, and this one showed a single branch directed towards the midrib and given off about 6 mm. from the point of origin of the lateral branch. About 10 lateral branches are given off on each side of the midrib in 10 mm., the distance between the carinae of two branches on the same side being from 0·82 to 1·35 mm., usually between 0·95 and 1·1 mm.; lateral branches on opposite sides of the midrib are alternating. The zooecial apertures are very small—about 0·08 mm. in diameter—and are surrounded by slight peristomes; when perfectly preserved they are stellate. There are two rows of apertures on both midrib and branches; on the midrib the zooecia are placed so that one aperture occurs at the point of origin of each lateral branch and one in the space between the branches. On the midrib there are about twenty apertures in 10 mm., the distance between the centres of successive apertures being 0·4 to 0·67 mm. The apertures are rather more closely spaced on the branches, 25 occurring in 10 mm., the distance between their centres being 0·36 to 0·44 mm. The carina forms a slight, straight or slightly sinuous ridge marked by a row of very fine granules along the centre of each branch; no nodes are developed. Both obverse and reverse surfaces are coarsely granular. When the reverse surface is slightly weathered it is marked by about ten strong longitudinal ridges and grooves on the midrib, and six on the branches.

PENNIRETEPORA FOSSATA, n. sp. Pl. v, fig. 6.

Horizon and locality: Callytharra Series, below Callytharra, Wooramel R.

Holotype: F 803, Commonw. Palaeont. Colln.

Flexuous Penniretepora, *apertures large, three between the origins of successive branches; obverse and reverse surfaces ornamented by coarse ridges and grooves; carina replaced by usually three continuous ridges, no nodes developed.*

The zoarium is pinnate; the midrib is flexuous, 0·47 to 0·63 mm. wide, giving off alternating lateral branches 0·35 to 0·55 mm. wide, spaced 1·1 to 1·7 mm. apart, with about 7·5 on each side of the midrib in 10 mm.; the lateral branches are given off at the

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Text-figs. 39-41.—*Rhabdomeson mammillata* (Bretnall), × 20. 39. Transverse section. 40. Vertical section. 41. Tangential section, from specimens (Slides 41202-4, Univ. W. Aust. Colln.) from the Nooncanbah Series at Mt. Marmion.

Text-figs. 42-43.—*Strebloclad ia excavata*, n. sp. Obverse and reverse surfaces of the holotype, × 20.

Text-fig. 44.—*Penniretepora granulata*, n. sp. Obverse surface of the holotype, × 20.

Text-figs. 45-46.—*Rhombocladia minor*, n. sp. Reverse and obverse surfaces of the holotype, × 20.

Text-fig. 47.—*Rhabdomeson bispinosa*, n. sp. Oblique section of the holotype, × 20.

Text-fig. 48.—*Rhombocladia spinulifera*, n. sp. Obverse surface of the holotype, × 20.

Text-fig. 49.—*Penniretepora triporosa*, n. sp. Obverse surface of the holotype, × 20.

angles of convex curvature of the midrib at angles of 50° to 75°. In two specimens lateral branches give rise to pinnae at distances of 1 mm. and 1·2 mm. from the main stem. The apertures are circular, and are very large, 0·16 × 0·14 mm. in diameter, and when perfectly preserved they are surrounded by slight but distinct peristomes. The distance between the centres of successive apertures on the midrib is from 0·43 to 0·56 mm., and about 20·5 apertures occur in 10 mm.; there is one aperture placed opposite the origin of each lateral branch, and two, rarely one, in the space between two branches. On the lateral branches the apertures are rather more closely spaced—0·43 to 0·48 mm. apart, with about 23 in 10 mm. Both obverse and reverse surfaces are ornamented by strongly developed and coarse longitudinal ridges and grooves; on the obverse surface these are mostly discontinuous, and swirl around the zooecial apertures, but along the centre of the branch there are usually three, less often two, more continuous ridges which replace the carina. No nodes are developed.

P. flexuosa (Moore) (1930, 161), from the Graham Formation of Texas, is a generally similar species, but differs in its slightly smaller size and in possessing a very strongly defined carina.

In addition to this species a number of fragments of a similar species of *Pennirelepora* occur in the material from below Callytharra; this second species has much smaller and more closely spaced apertures, which are stellate where they are perfectly preserved, and the lateral branches are given off from the midrib at much wider and more distant intervals, but the general appearance of the surface, here also ornamented by swirling ridges and grooves, is similar to *P. fossata*. A third associated species, similarly ornamented, is differentiated by the possession of a row of large, rather closely spaced nodes along the centre of the branches and has pyriform-stellate apertures. Neither of these species was represented by sufficiently well preserved material for description.

Genus Septopora Prout, 1859.

Genotype: *Septopora cestriensis* Prout, 1859.

Range: Mississippian to Permian.

Septopora Prout, 1859, 448; *Septopora* Prout, Moore, 1929*b*, 129; Bassler, 1929, 87.
Synonym: *Loculiporella* Frederiks, 1920.

"*Zoarium a fenestrate, flabellate or leaf-life expansion; primary branches numerous, increasing by bifurcation or interpolation; the lateral branches unite with those from the adjacent primary branches; apertures in two rows on primary and lateral branches; reverse usually with fine striae and scattered dimorphic pores.*" (Nickles and Bassler, 1900, 41.)

Small fragmentary specimens of *Septopora*, all apparently belonging to the same species, are fairly abundant in material from the Callytharra Series; the genus is not so far known to occur in other Permian strata in Western Australia, although one species of the allied genus *Synocladia* occurs in the Cundlego Series.

Septopora ornata, n. sp. Pl. iv, fig. 11; Pl. v, fig. 3.

Horizon and locality: Callytharra Series, west of Callytharra (holotype) and below Callytharra (F 804, Commonw. Palaeont. Colln.), Wooramel R., and at Well ↑ 20, Daurie Ck., Gascoyne R. district (on 2/2404 B, W. Aust. G.S. Colln.).

Holotype: F 796, Commonw. Palaeont. Colln.

Septopora *with thick branches joined by short, thick celluliferous dissepiments; usually 3 to 5 apertures on the main stem between successive lateral branches or dissepiments; accessory pores about equal in number to apertures on obverse surface, few on reverse; slight carina with large, distant nodes.*

The zoarium is pinnate, composed of strong, thick branches 0·57 to 1·5 mm. wide, which give off lateral branches of variable width but narrower than the stem from which they arise. The branches are united by curved celluliferous dissepiments, 0·27 to 0·7 mm. wide, and separated by fenestrules 0·6 to 1·15 mm. long; in 10 mm., according to measurements taken on the one or two fenestrules closest to the main stem, the only ones preserved in any of the specimens examined; there are about 8 fenestrules and dissepi-

ments; occasional dissepiments are non-celluliferous for a very short distance in the centre. About 6·5 branches are given off in 10 mm. on each side of the main stem, the distance between the carinae of successive branches being 1·14 to 2·3 mm.; there are usually three to five, but up to seven, apertures between successive branches. The obverse surface is flattened; the zooecial apertures occur in two rows, separated by a very slight median carina, on both branches and dissepiments; the apertures are circular, about 0·14 to 0·16 mm. in diameter, and there are about 27·5 apertures in 10 mm., the distance between the centres of successive apertures being from 0·28 to 0·46 mm. The apertures are frequently laterally displaced—so that their arrangement appears somewhat haphazard in some specimens—by the presence of small circular "accessory pores" about 0·08 to 0·1 mm. in diameter, which are about as numerous as the apertures on the obverse surface; these pores are commonly placed so that one lies between each pair of apertures longitudinally. The carina bears a single row of large, irregularly spaced, blunt nodes placed from 0·63 to 1·9 mm. apart, there being about 8 nodes in 10 mm.; the whole of the obverse surface is ornamented by very fine longitudinal striae, or is smooth and finely granular. On the reverse surface the dissepiments are not as thick as the branches; when well preserved, the surface of both branches and dissepiments is finely granular and is ornamented by a few small tubercles; accessory pores occur on this surface but are not very numerous; where the surface is worn numerous strong longitudinal striae are shown.

Genus Synocladia King, 1849.

Synocladia King, 1849, 388.

Genotype: *Retepora virgulacea* Phillips, 1829.

Range: Upper Carboniferous to Permian.

"*Zoarium as in* Septopora, *but branches stronger and with three or more rows of apertures, usually between elevated ridges*" (Nickles and Bassler, 1900, 41).

Synocladia spinosa, n. sp. Pl. v, figs. 1, 2.

Horizon and locality: Lower part of Cundlego Series, 8 chs. from Stn. H 5 towards H 12 on traverse along south bank of Whitfield's Creek (a side branch of the Minilya R.), Washpool Paddock, Wandagee Station (holotype); same horizon and approximately same bed, 20 chs. from Stn. H 4 towards H 5, same traverse as above (22321, Univ. W. Aust. Colln.); approximately same horizon, ¼ mile south-west of Cundlego Well, south bank of Minilya R., Coolkilya Paddock, Wandagee Station (22322, Univ. W. Aust. Colln.).

Holotype: 22134a, Univ. W. Aust. Colln.

Synocladia *with broad, thick branches and short, curved, celluliferous dissepiments; apertures in 3 to 5 rows, 5 or 6 apertures to a fenestrule; "accessory pores" about equal in number to apertures on obverse surface; nodes not numerous, but very large, rows of zooecia not separated by carinae.*

The zoarium is fenestrate, consisting of coarse, closely spaced, bifurcating branches joined by short, arched celluliferous dissepiments. In 10 mm. there are 4·5 to 6·5 branches horizontally and 5·5 fenestrules vertically. The branches are broad and thick, about 0·8 to 0·14 mm. in width, and are rather flattened on the celluliferous surface. The zooecial apertures are large, about 0·18 mm. in diameter, and were surrounded by thin, distinct peristomes; they occur usually in three to five rows on the branches, with about six rows immediately before bifurcation. The apertures are frequently displaced by the occurrence of the small, circular "accessory pores", which are about 0·1 mm. in diameter, and about equal the apertures in number, and also by the occurrence of occasional, but very large acanthopores, which form blunt nodes up to 0·25 mm. wide at the top; these nodes occur irregularly; generally there is one, sometimes more, to a fenestrule, and they sometimes occur on the dissepiments. Five or six apertures in each row occur in the length of one fenestrule and one dissepiment, with about 29 apertures in 10 mm.; the distance between the centres of successive apertures is 0·3 to 0·4 mm. The lateral rows of apertures often open towards the fenestrules. The fenestrules are oval

to crescentic in shape, and measure from 0·65 to 1·75 mm. in their maximum width and from 0·75 to 1·15 mm. in their greatest length. The dissepiments are usually arched, but may be almost straight, and they are about 1·45 to 2·15 mm. wide; they show two, three, or four rows of apertures spaced about as closely as those on the branches, with about an equal number of "accessory pores" and occasional acanthopores. Etched specimens show the direction of growth of the zooecia on the dissepiments, pinnately from the branches on each side. In shape, the zooecia are parallel to the basal plate for comparatively a very short distance, then curve sharply to a long vestibule. On the reverse surface both branches and dissepiments are rounded, but the dissepiments are very much thinner than the branches; both are ornamented by fine, discontinuous, pitted grooves; "accessory pores" occur very infrequently on this surface; occasional coarse rootlets occur.

Synocladia spinosa resembles the genotype, *Synocladia virgulacea* Phillips, from the Permian of England, Germany and India, more closely than other described species of the genus, but is differentiated by the arrangement of the apertures, the absence of carinae, and the strongly developed nodes.

Family Rhabdomesontidae Vine.

Genus Rhabdomeson Young and Young, 1874.

Rhabdomeson Young and Young, 1874, 337; *Rhabdomeson* Young and Young, Bassler, 1929, 69; Moore, 1929*b*, 141.

Genotype: *Millepora gracile* Phillips, 1841.

Range: Carboniferous to Permian.

Zoarium ramose, with slender cylindrical branches which give off lateral branches of the same size at intervals; zooecia rather short, diverging on all sides from a thin walled axial canal; zooecial walls thin in the axial region, strongly and evenly thickened in the peripheral region; diaphragms and hemisepta present or absent; acanthopores (sometimes of two sizes) well developed; apertures regularly arranged in longitudinal or in diagonal intersecting rows.

Rhabdomeson mammillata (Bretnall), 1926. Pl. v, fig. 14; Text-figs. 39–41.

Rhombopora mammillata Bretnall, 1926, 24, Pl. i, fig. 2; [*? non*] *Rhombopora mammillata* Bretnall, Hosking, 1931, 14; *Rhabdomeson shanse* Reed, 1934, 113, Pl. ii, fig. 3.

Horizon and locality: Nooncanbah Series, Mt. Marmion (see p. 142).

Holotype: Specimen 2 on 10930c, W. Aust. G.S. Colln.

Coarse Rhabdomeson, *axial canal large; zooecial apertures very regularly arranged in about 30 to 34 longitudinal rows, and in steeply intersecting diagonal rows; acanthopores large, one at each angle of each aperture.*

The zoarium is ramose, consisting of hollow cylindrical branches 1·8 to 2·15 mm. in width; branches are usually given off from the main stem at right angles, but occasionally it bifurcates to give two branches at right angles to each other. The apertures are oval, 0·2 to 0·27 mm. long and 0·13 to 0·17 mm. wide, and are arranged in very well marked longitudinal, transverse, and steeply intersecting diagonal rows. Longitudinally there are 23 to 24 apertures in 10 mm., the distance between the centres of successive apertures being 0·37 to 0·51 mm.; there are about 30 to 34 longitudinal rows of apertures. The interspaces are rounded, and are so arranged that they form well-marked diagonal ridges, cutting off rhombic areas containing the apertures. At each intersection of these ridges there is a single large, blunt acanthopore; no small acanthopores are developed.

The axial tube is rather thin walled, sub-circular in cross-section, and is from 0·36 to 0·6 mm. in diameter. It is not divided by diaphragms. The zooecia are short, and diverge from the axial tube at about 35° to 50°; the vestibules meet the surface at almost a right angle. The walls are strongly thickened in the cortical zone. Neither diaphragms nor hemisepta are developed. The acanthopores are large, blunt, and regularly placed at the angles of the apertures.

The figured specimen of *Rhabdomeson shanse* Reed, 1934, from the Anthracolithic Beds of Htam Sang in the Southern Shan States, is identical with this species; unfortunately the measurements given by Reed in the text do not in all cases correspond with those shown in the figure, but it is considered that the figured specimen at least should be referred to *R. mammillata* (Bretnall).

Bretnall records this species from the Callytharra Series at Fossil Hill, Wyndham River (F H a 2). There is now no specimen numbered "2" on any of Bretnall's material from this locality, and I have been unable to find any specimens of *R. mammillata* in material from the Callytharra either at this locality or from the Wooramel River district, where Hosking (1931, 14) has recorded its occurrence. It is possible that these records may refer to *Rhabdomeson bispinosa*, n. sp., in which the diagonal ridges are made prominent in weathered specimens, giving a similar "rhombic lattice" appearance.

Rhabdomeson bispinosa, n. sp. Text-fig. 47.

Horizon and locality: Callytharra Series, Fossil Hill, Wyndham R.

Holotype: On 2/2405 F, W. Aust. G.S. Colln.

Fine Rhabdomeson, *apertures regularly arranged in 14 to 16 longitudinal rows and in diagonal rows; acanthopores of two sizes, two large acanthopores in the longitudinal interspace between two apertures, small acanthopores not numerous.*

The zoarium is ramose; the branches are hollow, 0·95 to 1·1 mm. wide, the width of the axial tube being 0·2 to 0·27 mm. The apertures are oval, 0·17 to 0·24 mm. long by 0·08 to 0·11 mm. wide, and they are arranged in well-marked longitudinal and transverse and in steeply pitched diagonal rows. The distance between the centres of successive apertures in the same longitudinal row is 0·43 to 0·6 mm., and in each row there are 20 apertures in 10 mm.; there are about 14 to 16 rows of apertures. The interspaces are rounded, and as in *Rhabdomeson mammillata*, they are so arranged that they form well-marked diagonal ridges which cut off rhombic areas containing the apertures. There are two large acanthopores placed one above the other on the longitudinal interspace between two apertures, and in addition to these, a few small acanthopores (these are developed very close to the surface and are therefore not shown over most of the slide figured) occur on the ridges.

The axial tube is sub-circular in sections and is thin walled; it is not divided by diaphragms. The zooecia are short, and diverge from the axial tube at about 20°; the vestibules meet the surface at right angles. The walls are strongly thickened in the cortical zone, which is about 0·19 mm. wide. Neither diaphragms nor hemisepta are developed.

The arrangement of the acanthopores and the spacing of the apertures in this species is very similar to that in *Rhabdomeson consimile* Bassler, from the Basleo and Amarassi Beds of Timor; *R. consimile* is, however, of slightly larger size than this species, and has a larger axial tube, and differs in the angle at which the zooecia diverge from the axial tube and in possessing comparatively strong hemisepta; the acanthopores also appear to be larger and to originate deeper within the zoarium; because of these differences, especially the differences in internal structure, it seems best at present to consider these species distinct.

Genus Rhombopora Meek, 1872.

Rhombopora Meek, 1872, 141; *Rhombopora* Meek, Ulrich, 1890, 402, 647; Moore, 1929, 137.

Genotype: *Rhombopora lepidodendroides* Meek, 1872.

Range: Ordovician to Permian.

Zoarium ramose, branches without axial tube; zooecia long and tubular, otherwise as Rhabdomeson.

Rhombopora multigranulata Bretnall, 1926. Pl. v, fig. 13; Text-figures 35, 36.

Rhombopora multigranulata Bretnall, 1926, 25, Pl. i, fig. 3; [*non*] *Rhombopora multigranulata* Bretnall, Hosking, 1931, 14, Pl. iv, fig. 4.

Horizon and locality: Nooncanbah Series, Mt. Marmion (see p. 142).

Holotype: Specimen 3 on 10930 c, W. Aust. G.S. Colln.: Bretnall lists specimen 3 on 10930 a as a paratype; there are two specimens labelled "3" on 10930 a, of which only the smaller belongs to this species.

Fine Rhombopora, *zooecial apertures long and oval, in 13 to 15 longitudinal rows; interspaces with numerous fine acanthopores.*

The zoarium is fine and ramose, with solid cylindrical branches, 0·92 to 1·1 mm. in diameter, which branch at intervals of 5 mm. or more; the angle between the branches after division is usually about 80°, but is up to 110°. The apertures are arranged in about 13 to 15 longitudinal rows, and in generally better marked diagonal rows; they are elliptical, 0·24 to 0·29 mm. long and 0·11 to 0·14 mm. wide; the distance between the centres of successive apertures in the same longitudinal row is 0·54 to 0·9 mm., and in each row there are about 14 apertures in 10 mm. The interspaces between the apertures are broad and rounded, and occasionally show slight longitudinal grooves. The acanthopores are small and numerous; they occur in one or two rows on the interspaces, and about 13 to 17 surround each aperture. No mesopores occur.

The zooecia are tubular and rather short, and are without hemisepta or diaphragms; the cortical zone is comparatively thick, comprising about 0·5 to 0·6 of the radius. The zooecia bend sharply from the axial to the cortical zone, and the vestibules usually meet the surface at almost a right angle.

The original description of this species does not apply very closely to the holotype or to other specimens which Bretnall labelled as conspecific with it. The species recorded and figured by Hosking from two localities in the Wooramel River district is a larger and much coarser form. *R. multigranulata* resembles in appearance *R. exigua* Ulrich 1890, with which Etheridge has compared it, but is a decidedly larger form.

Genus Streblotrypa Ulrich, 1890.

Streblotrypa Ulrich, 1890, 403, 665; *Streblotrypa* Ulrich, Bassler, 1929, 66.

Genotype: *Streblotrypa nicklesi* Ulrich, 1884.

Range: Ordovician to Permian.

Zoarium ramose, slender, solid; zooecia tubular, radiating from an imaginary axis at the centre, with the immature region long, or rarely from a linear axis, when the zooecia are shorter, or the central part of the zoarium may be occupied by a bundle of small tubes from which the zooecia diverge towards the surface; zooecial tubes usually with hemisepta; apertures elliptical, sometimes truncated at the posterior margin, arranged in regular longitudinal series; below the apertures, occupying the depressed front of the cell, are from one to twelve, or more, small "mesopore pits", separated by longitudinal ridges between the rows of zooecia, which are generally straight but occasionally flexuous; very small acanthopores, placed close to the apertures, present in some species.

Streblotrypa marmionensis Etheridge, 1926. Pl. v, figs. 10, 11; Text-figs. 31–34.

Streblotrypa marmionensis Etheridge, 1926, in Bretnall, 22, Pl. i, fig. 1, and Pl. ii, fig. 3; *Streblotrypa marmionensis* Etheridge, Hosking, 1931, 14, Pl. iv, fig. 1, and text-fig. 1; [?] *Streblotrypa germana* Bassler, 1929, 67, Pl. ccxxxix (15), figs. 6–10.

Horizon and locality: The holotype is from the Nooncanbah Series at Mt. Marmion; this species is one of the most widespread and abundant species in the collections from the Western Australian Permian, and it occurs abundantly at numerous localities in the Callytharra, the Barrabiddy shale series and the Cundlego, Wandagee and Nooncanbah series.

Holotype: F 17458, Aust. Mus. Colln. Of the paratypes listed by Bretnall, the following are here considered to be typical specimens of this species: "1" on 17539, 17540 (larger specimen only), 17541–2, 17547–51, 17559.

Ramose Streblotrypa, *with cylindrical branches with usually 16 to 20 rows of apertures, and with distinct areas of pits marked off by longitudinal ridges, and each containing 4 to 12 mesopore pits, posterior to the apertures.*

The zoarium is ramose, arising from an encrusting base; the branches are solid, and cylindrical, typically between 1·0 and 1·6 mm. wide, although occasionally slightly

finer or coarser specimens with the same zooecial characters occur. The zooecia are in about 15 to 24—usually between 16 and 20—longitudinal rows; the zooecial apertures are oval, or may be slightly truncated at the posterior end, and are 0·14 to 0·21 mm. long by 0·1 to 0·14 mm. wide; the distance between the centres of successive apertures is 0·32 to 0·68 mm., and about 22 occur in each row in 10 mm. The front of the cell is slightly depressed, and is perforated by usually from 4 to 12 mesopore pits. The development of ridges between the rows of zooecia varies considerably even in the one specimen; characteristically the rows of zooecia are separated by straight, strong ridges, but the ridges in some specimens are sinuous, and in some places the divisions between each row of mesopore pits in the areas below the apertures are so strongly developed that they form irregular ridges; in many specimens the ridges have been removed by weathering. Branching occurs at very irregular intervals—at times twice within 2 or 3 mm.; in other specimens it does not occur in more than 2 cm.; and the angle of branching varies greatly in any one specimen. The branches formed after division are frequently marked by a very strong development of the mesopore pits for the length of one or two zooecia after branching.

Internally this species shows the central bundle, occupying about one-quarter of the radius, of small parallel tubes characteristic of later members of the genus. The posterior wall of each zooecium contains the thick walled mesopore-like pits. Small inferior hemisepta are placed well within each zooecium. Superior hemisepta are not developed, and there are no diaphragms. In a number of specimens some apertures were closed by a thin, ornamented plate placed about midway down the vestibule, as shown in some of the tubes in the transverse section figured in Text-fig. 33. No acanthopores are shown. The zooecia bend sharply to the vestibule at an angle of 65° to 75°, and the vestibules and pits meet the surface at right angles. The width of the mature zone is about 0·3 mm.

Bretnall (1926) included in his paper descriptions of two species of *Streblotrypa*, *S. marmionensis* and *S. etheridgei* Bretnall. As has been pointed out by Hosking (1931, 15), the descriptions do not correspond well with the plates, and she suggested that in the explanation of Plate i the specific names had been interchanged. Both figures of *Streblotrypa* given on this plate by Bretnall are apparently diagrammatic illustrations of *S. marmionensis*, the longitudinal ridges of the specimen figured in Fig. 1 having been removed by weathering. Neither his Fig. 1 nor Fig. 7 could be a figure of the holotype of *S. etheridgei*.

There is considerable variation in specimens of *S. marmionensis* in the number and arrangement of the mesopore pits, and in the distance between the apertures. Although in some zoaria there are a more or less uniformly small or large number of pits, and the apertures are either fairly closely or fairly widely spaced, with short and broad or with long and narrow cell fronts, in the great majority of specimens these characters are extremely variable. The mesopore pits are of fairly constant size, except of course where they have been enlarged by weathering; there is an associated species of slightly larger size in which the pits are smaller, more numerous and thinner walled, and the base of the posterior wall of the zooecium which contains them is inclined at a greater angle to the surface (cf., *S. fasiculata* Bassler, 1929).

Streblotrypa germana Bassler, from the Permian Basleo and Amarassi Beds of Timor, is very probably identical with this species. According to the description, *S. germana* is a smaller form with slightly larger apertures, but the figured specimens are so very similar in size and appearance to specimens from Western Australia that they should probably be referred to the same species.

STREBLOTRYPA ETHERIDGEI Bretnall, 1926. Pl. iv, fig. 12; Text-figs. 37, 38.

Streblotrypa etheridgei Bretnall, 1926, 23, not Pl. i, fig. 7.

Horizon and locality: Nooncanbah Series, Mt. Marmion (holotype), Coll. H. Basedow; and Nooncanbah Series, ½ mile west of fence, Duchess Ridge, West Kimberley district.

Holotype: F 17550, Aust. Mus. Colln.; of other specimens listed by Bretnall as belonging to this species, specimen 5 on 10930 c, W. Aust. G.S. Colln., belongs here, but specimen 5 on F 17555, Aust. Mus. Colln., does not belong to this species, and there is now no specimen labelled "5" on F 17554, Aust. Mus. Colln., nor is there any specimen of *S. etheridgei* on this specimen.

Ramose Streblotrypa; *apertures oval, rows of zooecia not separated by strong longitudinal ridges; about 11 to 13 small mesopore pits in area beneath each aperture, with one additional large pit placed immediately above each aperture; central bundle of small tubes developed; zooecial tubes with both inferior and superior hemisepta.*

The zoarium is ramose; the holotype has a normal width of about 2 mm., but is wider before division of the branch occurs. The zooecial apertures are oval, about 0·18 to 0·22 mm. long and 0·11 to 0·15 mm. wide, and are surrounded by very slight peristomes. The apertures are arranged in about 30 longitudinal rows, and in steeply pitched diagonal rows. In each row the apertures are rather widely spaced, the distance between their centres being about 0·45 to 0·7 mm., the spacing becoming rather closer just before bifurcation than it is on the rest of the branch. In the holotype there are about 16·5 apertures in each row in 10 mm. The rows of apertures are not separated from each other by strong longitudinal ridges; the areas of mesopore pits beneath the apertures each contain about eleven to thirteen small pits, with one additional much larger pit placed immediately above each aperture; this large pit is usually oval, with its longer diameter at right angles to that of the aperture, or is slightly crescentic in outline, and it may be up to 0·11 × 0·6 mm. in diameter; the small mesopore pits are usually about 0·3 mm. in diameter, and are arranged in a fairly constant pattern, with two lateral, slightly curved rows, each of about five pits, separated by a median ridge, which bifurcates below the aperture, and in the small triangular space thus formed there are from one to four more pits.

Internally, the central part of the zoarium is occupied by a bundle of smaller vertical tubes about 0·65 mm. in diameter; the zooecia on each side are placed at an angle of about 25° to 30° to these tubes, and when they reach the cortical zone they bend sharply to meet the surface at right angles. No diaphragms are developed, but both superior and inferior hemisepta occur, both placed well within the tubes, the inferior hemisepta being rather closer to the surface than the superior.

Well-preserved specimens of this species are clearly differentiated from the much more common *S. marmionensis* by their surface characters, and particularly by the presence of one much enlarged mesopore pit above each aperture, and by their larger size; on weathered surfaces, the difference in the surface appearance between these species is not always so distinct—on one surface of the holotype which had been exposed by weathering and which Bretnall described, the walls between the large pits and the apertures had been broken down so that the apertures appeared long and oval and the tubes seem to meet the surface obliquely, and on this surface the appearance is not very different to that of weathered specimens of *S. marmionensis*; in other specimens the large pit has been made more prominent by weathering where its infilling has been more resistant to weathering than the surrounding walls.

Bretnall's Pl. i, fig. 7, is apparently taken from a specimen of *S. marmionensis*, and could not possibly be a figure of the holotype of *S. etheridgei*.

There is no described species of *Streblotrypa* with which this species could be closely compared.

Genus Rhombocladia Rogers, 1900.

Rhombocladia Rogers, 1900, 11; *Rhombocladia* Rogers, Moore, 1929*b*, 148.

Genotype: *Rhombocladia delicata* Rogers, 1900.

Range: Pennsylvanian to Permian.

Zoaria consisting of compressed, dichotomously dividing or irregularly reticulating stems, poriferous on one surface; acanthopores, sometimes of two sizes, abundant between the apertures on the obverse surface; reverse surface covered by a thin lamina ornamented by growth lines. Zooecia tubular, as in Rhabdomeson, *arising from the*

reverse surface and approaching the obverse surface obliquely; vestibules shallow, vertically walled; hemisepta present, diaphragms present or absent.

Moore (1929*b*) has very clearly re-described the genotype of *Rhombocladia*, which is "not uncommon in Pennsylvanian strata at widely different stratigraphic horizons in Texas, Oklahoma, and Kansas" and in Missouri; *R. delicata* has also been recorded and figured (Johnsen, 1906, 158, Pl. xi, figs. 30*a*, *b*) from the Fusulina Limestone of the Carnic Alps. Nikiforova (1934, 394) has recorded but not described a second species, *R. donaica*, from the Upper Carboniferous of the Djulfa Basin in Russia. It is therefore very interesting to find two distinct species of this rare genus in the Permian of Western Australia, one a fairly abundant form in the Callytharra and the other a rare form in the Nooncanbah Series.

Rhombocladia minor, n. sp. Pl. v, fig. 5; Text-fig. 45, 46.

Horizon and locality: Callytharra Series, below Callytharra (holotype) and west of Callytharra (F 798, Commonw. Palaeont. Colln.), Wooramel R.

Holotype: F 805, Commonw. Palaeont. Colln.

Very fine Rhombocladia, *zooecia usually in three rows, acanthopores numerous and very fine; reverse surface flattened.*

The zoarium is irregularly reticulate, consisting of narrow, compressed branches, 0·46 to 0·57 mm. wide, and poriferous on one surface only; the branches bifurcate at intervals of about 1·5 to 2 mm., and in some fragments adjacent branches unite after bifurcation, so that some reticulation of the branches of the colony apparently occurred. The obverse surface is strongly convex and bears three, very rarely two, rows of zooecial apertures; the interspaces between the apertures are rounded and are ornamented by very numerous, tiny acanthopores, usually in two rows where the interspaces between the apertures are narrow and closely scattered on the broader interspaces; no large acanthopores occur. The apertures are oval, 0·24 to 0·29 mm. long and 0·1 to 0·15 mm. wide, and the centres of successive apertures in the same row are spaced 0·49 to 0·84 mm. apart, with about 16 in 10 mm. The vestibules are very shallow, but their walls are vertical. The reverse surface is flat and is covered by a very thin, semi-transparent lamina, ornamented by forwardly-directed U-shaped growth lines. The outlines of the recumbent parts of the cells are clearly shown through this lamina, and their shape is the same as that described by Moore in his revision of *R. delicata*. No diaphragms could be seen, and the hemisepta, if present, would not be visible in the part of the cells shown. This lamina projects to form a narrow flange around the obverse surface. Unfortunately the specimens are so fragmentary and so fragile that making thin sections proved impracticable.

This species is represented by abundant small fragments in material from the Callytharra. It is a much smaller species than *R. delicata*.

Rhombocladia spinulifera, n. sp. Text-fig. 48.

Horizon and locality: Nooncanbah Series, Keevie's Well, 8 miles north of Mt. Anderson Homestead.

Holotype: 20944*b*, Univ. W. Aust. Colln.

Rhombocladia *with zooecia in four to six rows, acanthopores numerous, small, in a single row on the interspaces.*

The zoarium is irregularly reticulate, composed of compressed branches 0·7 to 0·95 mm. wide, poriferous on one surface only. The branches bifurcate rapidly, at times within 3 mm., and there was apparently also some irregular reticulation of the colony. The obverse surface is convex, and there are usually from four to six rows of zooecial apertures, but the number of rows and the arrangement of the apertures in them is somewhat irregular because of the rapid bifurcation of the branches. The interspaces between the apertures form ridges which bear a single row of small acanthopores, about 20 around each aperture; no large acanthopores occur. The apertures themselves are oval but the ridges around them are, in places, hexagonal in shape; the vestibules slope steeply inwards from the interspaces, except at the posterior end of the apertures, where there is at times a flattened area behind the aperture; the apertures are 0·19 to 0·24 mm.

long by 0·16 mm. wide, and the distance between the centres of successive apertures where they are regularly arranged in rows is 0·47 to 0·56 mm. The reverse surface is flat, and is covered by a thin lamina on which there are very faint U-shaped growth lines; this lamina may project and form a narrow flange around the edges of the obverse surface.

Genus Strebleocladia, n. gen.

Genotype: *Strebleocladia excavata*, n. sp.

Range: Upper Pennsylvanian to Permian.

Zoarium consisting of compressed dichotomously dividing or irregularly reticulate branches; branches celluliferous on one surface only; apertures elliptical, spaces between them at the surface occupied by numerous shallow pits of irregular shape; acanthopores absent; thin basal lamina with fine growth lines on reverse surface; internal structure as in Rhombocladia.

This genus differs from *Rhombocladia* in much the same way as *Streblotrypa* differs from *Rhombopora*, except that the inter-apertural pits on the obverse surface are much shallower and much less regularly arranged than in *Streblotrypa*.

Numerous fragmentary specimens of *S. excavata* were associated with *Rhombocladia minor* in material from the Callytharra; *Septopora* ? *elliptica* Warthin, 1930, from the Wewoka and Holdenville Formations (Upper Pennsylvanian) of Oklahoma, is congeneric with this species; the zoarium of *S. elliptica* is described as "irregularly reticulate", and the same type of zoarium is developed in some specimens of *Rhombocladia minor* from Western Australia described here.

Strebleocladia excavata, n. sp. Pl. v, fig. 7; Text-figs. 42, 43.

Horizon and locality: Callytharra Series, below Callytharra (holotype), and west of Callytharra (F 799, Commonw. Palaeont. Colln.), Wooramel R.

Holotype: F 806, Commonw. Palaeont. Colln.

Fine Strebleocladia, *zooecia in two to three rows, surface between the apertures divided into shallow pits; reverse surface convex, obverse surface flattened.*

The zoarium consists of narrow, compressed, dichotomously dividing branches, 0·4 to 0·6 mm. wide, with successive bifurcations spaced about 1·5 to 2·5 mm. apart. The branches are celluliferous on one surface only. The obverse surface is flattened, and there are three, less often two, more or less regularly arranged rows of zooecial apertures separated by broad, flattened, slightly depressed interspaces. The zooecial apertures are oval, about 0·32 mm. long and 0·14 mm. wide, and their centres are spaced 0·6 to 0·98 mm. apart, with about 13·5 apertures in each row in 10 mm. The apertures are surrounded by slightly raised, narrow, distinct peristomes; the vertically walled vestibules are very shallow, and within them the cells bend sharply backwards towards the basal lamina. The surface between the apertures is divided into shallow, irregularly shaped pits; there is frequently one larger and deeper pit of fairly regular shape (broad close to the aperture and narrowing gradually backwards) placed at the proximal end of the aperture. No acanthopores occur. The reverse surface is broadly convex, and is covered by a thin basal lamina, which forms also a thin, upwardly directed flange along the edges of the obverse surface; the reverse surface is ornamented by fine forwardly directed U-shaped growth lines, parallel to the growing end of the branch. The basal lamina is very thin and is semi-transparent, so that, as in *Rhombocladia minor*, the outlines of the cells can be plainly seen through it.

Index to Genera and Species.

The horizon from which each species is recorded in this paper is indicated as follows:

C., Callytharra Series; B., Barrabiddy Shale Series; Cun., Cundlego Series; W., Wandagee Series; N., Nooncanbah Series.

An asterisk indicates that previous records of the species have been from outside Western Australia, or from a different horizon in Western Australia.

Summary.

In this paper thirty-six species of Bryozoa, referred to the genera *Fistulipora*, *Hexagonella*, "*Sulcoretepora*", *Goniocladia*, *Fenestrellina*, *Minilya*, *Protoretepora*, *Penniretepora*, *Septopora*, *Synocladia*, *Rhabdomeson*, *Rhombopora*, *Streblotrypa*, *Rhombocladia*, and one new genus, *Streblocladia*, are revised, described as new, or are recorded from Permian strata in the North-West Basin and Kimberley district of Western Australia. This paper includes revision of six species whose descriptions were published in 1926 by R. W. Bretnall (as *Coscinium* (?) *australe* Bretnall, *Sulcoretepora* (?) *meridianus* Etheridge, *Rhombopora multigranulata* Bretnall, *R. mammillata* Bretnall, *Streblotrypa marmionensis* Etheridge, and *S. etheridgei* Bretnall) from the type material, and also includes descriptions of specimens from the Callytharra Series previously recorded by F. Chapman in 1936 as *Fenestella pectinis* Moore, *F. spinulifera* Moore, and *Pinnatopora trilineata* var. *texana* Moore, species which were originally described from the Upper Pennsylvanian of Texas; these determinations are not confirmed here.

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EXPLANATION OF PLATES IV-V.

Plate iv.

Fig. 1.—*Fistulipora crescens*, n. sp. Lateral view of a topotype (22123*b*, Univ. W. Aust. Colln.), × 1.

Fig. 2.—*Hexagonella densa*, n. sp.—Holotype, × 1.

Fig. 3.—*Hexagonella australe* (Bretnall). Holotype, × 1.

Fig. 4.—*Hexagonella lineata*, n. sp. Surface of a topotype (F 17569, Aust. Mus. Colln.), × 1.

Fig. 5.—*Fenestrellina chapmani*, n. sp. Obverse surface of a topotype (F 789, Commonw. Palaeont. Colln.), × 10.

Fig. 6.—*"Sulcoretepora" meridianus* (Etheridge). Surface of the holotype, × 10.
Fig. 7.—*Minilya amplia*, n. sp. Obverse surface of the holotype, × 10.
Fig. 8.—*Fenestrellina alia*, n. sp. Obverse surface of the holotype, × 10.
Fig. 9.—*Fenestrellina sparsigemmata*, n. sp. Obverse surface of the holotype, × 10.
Fig. 10.—*Fenestrellina affluensa* (Bretnall). Obverse surface of a specimen (F 782, Commonw. Palaeont. Colln.) from the Callytharra Series, west of Callytharra, × 10.
Fig. 11.—*Septopora ornata*, n. sp. Obverse surface of the holotype, × 10.

Plate v.

Figs. 1-2.—*Synocladia spinosa*, n. sp.. 1. Natural mould of the obverse surface of a topotype (22134*b*, Univ. W. Aust. Colln.), × 10. 2. Obverse surface of the holotype, × 10.
Fig. 3.—*Septopora ornata*, n. sp. Obverse surface of the holotype, × 10.
Fig. 4.—*Penniretepora triporosa*, n. sp. Obverse surface of the holotype, × 10.
Fig. 5.—*Rhombocladia minor*, n. sp. Obverse surface of the holotype, × 10.
Fig. 6.—*Penniretepora fossata*, n. sp. Obverse surface of the holotype, × 10.
Fig. 7.—*Strebloclada excavata*, n. sp. Obverse surface of the holotype, × 10.
Fig. 8.—*Goniocladia timorensis* (Bassler). A specimen from the Nooncanbah Series, 9 miles E.N.E. from Trig. Stn. G2, St. George's Ra. (2757*e*, Univ. W. Aust. Colln.), showing the base and part of the reverse surface of the colony, × 1.
Fig. 9.—*Penniretepora granulata*, n. sp. Obverse surface of the holotype, × 10.
Figs. 10-11.—*Streblotrypa marmionensis* Etheridge. 10. Surface of a topotype (F 17551, Aust. Mus. Colln.), showing the appearance of the surface in very well preserved specimens, × 10. 11. Surface of the holotype, which is a rather weathered specimen, in which the longitudinal ridges between the rows of zooecia do not form such a prominent feature on the surface, × 10.
Fig. 12.—*Streblotrypa etheridgei* Bretnall. Surface of the holotype, × 10.
Fig. 13.—*Rhombopora multigranulata* Bretnall. Surface of the holotype, × 10.
Fig. 14.—*Rhabdomeson mammillata* (Bretnall). Surface of the holotype, × 10.